







EXECUTIVE COMMUNICATION,

ENCLOSING THE

REPORT OF ELWOOD MORRIS, Esq.,

Chief Engineer of the Chesapeake and Ohio Canal Company,

DECEMBER 31, 1840.

EXECUTIVE COMMUNICATION, &c.

BY THE HOUSE OF DELEGATES

January 8th, 1840.

Read and referred to the Committee on Internal Improvements.

Message of Gov. GRASON, to the Legislature, enclosing the report and Letter of the President of the Canal Company with the Report.

January 7, 1841.

To the House of Delegates :

I send herewith a communication, which has just been received from the President of the Chesapeake and Ohio Canal Company.

WM. GRASON.

Letter from F. THOMAS Esq., President of the Chesapeake and Ohio Canal Company, accompanying the Report of the Engineer.

OFFICE OF THE CHESAPEAKE AND OHIO CANAL CO.

Frederick, January 5, 1841.

SIR:—I have the honor to forward to you, to be communicated to the Legislature of Maryland, a report from the Chief Engineer of the Chesapeake and Ohio Canal Company, treating of the canal now under construction, and noticing briefly, the condition and prospects of that part of the canal now navigable.

Mr. Morris has been recently appointed to the important office he now holds. and his report, as an act of justice to him, the President and Directors desire to have laid before the Legislature, that the members thereof, and the stockholders of the canal company, may judge of his qualifications for the duties he is called upon to discharge.

The information called for, by an order of the House of Delegates, of the 30th of December, shall be communicated as

soon as the officers, who have in charge this preparation, have made out the necessary statements.

Very respectfully, yours &c.

FRANCIS THOMAS, *President.*

His Excellency,

WM. GRASON, *Governor of Maryland.*

Report of Ellwood Morris, Chief Engineer of the Chesapeake and Ohio Canal.

CHESAPEAKE AND OHIO CANAL LINE,

December 31st, 1840.

To the President and Directors of the Chesapeake and Ohio Canal.

GENTLEMEN :—Pursuant to your order of December 15th 1840, directing me to report, —1st. Generally upon the State of the work above dam No. 6.—2nd. Upon its probable aggregate cost, and the amount of work now done and to be done &c. &c.

I have the honor to submit the following Report, which though somewhat more general, will be found to comprise the 1st head of your instructions.

And with a view to perspicuity, I propose to treat the subjects considered, in three divisions :

- 1.—Entering succinctly into the history and design of the work, viewing it as a route connecting the Western waters with the sea.
- 2.—Treating of the canal now under construction from Cumberland 50 miles down stream to dam No. 6.
- 3.—Noticing briefly the condition and prospects of the finished Canal, now navigated upstream from Georgetown to dam No. 6. a distance of 134 miles.

It was both my wish and design to accompany my report at this time with a minute estimate of the probable cost of completing the unfinished 50 miles, and of the work done and to be done as required by the 2nd head of your instructions :

But, owing to an unavoidable absence from the line during all November, in attendance upon the United States Court, and also to the absence of certain original data—officially prepared in 1839 by the numerous officers then in service and deposited in the office of the Chief Engineer at Cumberland ; which data, it is singular, is not now to be found either there or in the Canal Office at Frederick, having evidently been abstracted by some one—I find myself unable to accomplish that pur-

pose at present, but intend to supply such an estimate as an appendix hereafter, so soon as the data contained in those missing documents can be restored ;* and this appendix I shall take steps to place in your hands, on or before the 15th day of February next ; this period with the limited aid I now have upon the line, will be the earliest moment at which I shall be able satisfactorily to fulfil your orders—and that I should be compelled by untoward circumstances to delay it thus long, none can regret more deeply than myself.

Until by the estimate to which I refer, more exact information can be supplied to the Directory, I will by the aid of the 12th Annual Report, make for their information a Statement of the work done and to be done, if the estimate of my predecessor of December 1839 should prove to be correct.

*Work done during all 1840, upon the 50 Miles of unfinished Canal
below Cumberland.*

WORK DONE.	From Jan. 1st to May 1st 1840	From May 1st to Dec. 31st 1840	In all 1840
Upon the Sections, - - - - -	\$137,060 29	\$304,166 67	\$441,226 96
Upon the Masonry, - - - - -	22,288 13	67,645 54	89,933 67
Upon all the species of work, - -	159,348 42	371,812 21	531,160 63

By this statement, derived from the actual estimates made to contractors up to January 1st, 1841, it appears that work to the amount of \$531,160 has been actually done in all 1840.

From information contained in the 12th annual report, we find that,

On the 1st of May 1840, work done on the 50 miles of unfinished Canal, amounted to	\$2,242,945
To this add, work done from May 1st 1840 up to January 1st 1841	371,812
And we have, Total work actually done upon the 50 miles up to January 1st 1841	2,614,757

*The correspondence which has been annexed to this Report by order of the Directors (which see) gives more ample information concerning the missing documents here alluded to ; the abstraction and withholding of which have delayed my estimate.

My predecessor, both in his revised estimate of December 1838 and in that again revised of December 1839, states the probable aggregate cost of the 50 miles of Canal alluded to at, \$4,440,657
 From which deduct work done January 1st 1841 2,614,757
 And by that estimate there will now be required to —————
 complete the Canal an expenditure of 1,825,900

But my personal knowledge of the exact state of the unfinished line, together with the progress already made in the estimate I shall hereafter present, justifies me in the confident expectation that, by dispensing with some works not absolutely necessary—By building the remaining locks of Rubble stone Masonry (a mode not equal to that now adopted, but better suited to your financial condition)—by modifying the construction of some other works, and—by the probable reduced rates at which with present prospects, the remaining work could now be let, an economical and judicious outlay upon the works, of a sum *not exceeding* \$1,600,000 more, would enable you within 2 or 2½ years, to open the navigation of the Canal from the Cumberland dam, throughout the 50 miles now unfinished, and thereby to complete the long anticipated continuous navigation from the county seat of Allegany, to tide-water within the District of Columbia.

1.—ON THE GENERAL DESIGN OF THE CHESAPEAKE AND OHIO CANAL.

The topography of the continent of North America, southward of the great chain of lakes, is remarkably simple in its general features; it consists of one magnificent valley—that of the Mississippi—of two mountain ranges—the Rocky mountains and the Alleghanies—and of two sea slopes—the eastern draining into the Atlantic, and the western into the Pacific Ocean.

About three centuries ago, civilization first set foot upon the Atlantic Slope and extending her domain gradually along the seaboard, it is scarcely a single century since the first settlements were planted beyond the Alleghanies, in the eastern margin of the great valley referred to.

But within this short period, our enterprising countrymen have extended themselves so rapidly, as now to occupy the whole eastern slope of the Mississippi valley and a portion of the western. The great central valley having been mainly peopled by immigration from the Atlantic slope, and much of the foreign trade in articles of western consumption being still carried on through

the Atlantic seaports, which afford reciprocally a market for the products of western industry; it was very natural that our countrymen, both in the East and West, should early contemplate perfecting the communications between their old and new homes, even by subduing the obstacle, which nature had appeared in those numerous mountain ranges known as the Alleghanies. Accordingly, we witness the great States of the seaboard, at immense expense, vying with each other in establishing magnificent lines of transportation, to secure to themselves as far as practicable, the traffic of that vast basin from which they are separated by the lofty crests of the Apalachian chain.

Stupendous are the barriers interposed by nature, but dazzling the stake they play for—costly must be the honorable strife, but splendid the reward accruing to that State which shall ultimately possess the most perfect line of western communication.

The trade with the great West, naturally divides itself into two distinct branches—one light, demanding expedition, the other heavy, in which time is less an object; with extraordinary facilities for both, nature has singularly favored Maryland

These advantages were early perceived and appreciated, by those valiant men who led the chivalry of the seaboard, in that illstarred march, which terminated on the fatal field near Fort Duquesne, where Braddock fell a victim to his inexperience in woodland warfare.

There was one commander in that army whose quick eye, was ever ready to note topography for future use—who had antecedently pursued his humble occupation of surveyor upon the margin of the Potomac, having been for some time posted, upon the present farm of Mr. George Catlett, about 8 miles below your Tunnel—and whose comprehensive mind quickly grasped the vantage offered by the valley of the Potomac as a western route, owing to that stream severing in succession, every one of the numerous rocky ranges, known by the general name of the Alleghany Mountains.

This officer—Washington himself—was the early and steadfast patron of improvements upon the line of the Potomac; and soon after the revolutionary peace, in fact on the 22nd of December 1784, we find General Washington sitting as chairman of a joint commission of Maryland and Virginia, to take into consideration the propriety of improving the navigation of the

Potomac to a point high upstream, and thence opening a road to join the western waters.

This commission recommended to the Legislatures of the two States, the appropriation of a sum of money towards rendering the Potomac navigable to a point considerably west of Cumberland; thence to form a road cleared 80 feet wide to the Dunker bottom, or the Cheat river, and thence to form a batteau navigation to the Monongahela.

This action clearly indicates that Washington and his compatriots looked upon the improvement of the Potomac merely as forming a link in a great route west.

At that early period no one believed it practicable to surmount the Allegany, by a continuous navigation, the demonstration of this momentous fact was reserved for those able officers of Engineers, who under the direction of the U. S. Board of internal improvements, made in 1826, the preliminary surveys for the present Chesapeake and Ohio Canal, and who then established in a most scientific and conclusive manner, that the Allegany summit of this work, actually possesses a command of water, ample to meet the exigencies of trade.

In 1784 the Potomac was chartered by the commonwealths of Maryland and Virginia, who subsequently commenced operations under that charter and effected an essential amelioration of the navigation of the river, especially at the Great and Little Falls; but their improvements being found in 40 years to fall far behind the wants of the country, they were superseded in 1824 by the charter of the present Chesapeake and Ohio Canal Company, to whom all the rights, interests, and privileges, of the Potomac Company, were ceded by a deed of surrender, dated the 16th of May 1825.

The Chesapeake and Ohio Canal Company was organized in 1825, and on the 4th day of July 1828, the first ground was broken upon the canal, by his Excellency John Quincy Adams, the Chief Magistrate of the Republic: since that day, with various fortune, this great work has struggled onward, deserted within a few years by all her early patrons, except the commonwealth of Maryland, in whose bosom alone she has of late been fostered.

Although this important enterprise is evidently destined for many years to be nothing more than the Georgetown and Cumberland—or at the most, the Baltimore and Cumberland canal—still as it was originally designed to connect the western waters with the sea, by an artificial navigation, and as the day

may come when Maryland will find herself free from debt, and ready perhaps to reap the fruits of her geographical position, it may be as well to notice briefly the physical advantages which nature has lavished on this State, by laying through her bosom the only western route, possessing a summit sufficiently well watered to guarantee the maintainance of a continuous navigation across the mountains; which by its superior economy in the carriage of the heavy and slow trade, would inevitably enable its proprietor, to disregard and overthrow the competition of all the rival lines in such a traffic.

Whoever studies a map of the United States, will perceive these facts—the Erie Canal turns the north eastern flank of the Apalachian chain, by an admirable water route; whilst Tennessee and Georgia with their improvements turning its flank in the south western quarter, have been compelled to resort to rail roads; and of all the western lines of transport between these limits, surmounting the crests of the Alleghany, none are practicable without a railway portage—save the Maryland route alone—with this line, but two can by any possibility enter into competition, and these are the Pennsylvania and Virginia routes, the relative advantages of which will be perceived by a comparison of the following tabular statements.

VIRGINIA ROUTE,

From tide water on the seaboard to steam boat navigation on the western waters.

TERMINI.	Character of Improvement.	Length in miles.	Height of the Alleghany summit above tide in feet.	Total Ascent and Descent in feet.	Miles of Canal.	Miles of Rail Road.
Richmond to Covington, Covington to the Kanawha,	Canal R'l R'd	239 138	1987	1229 2137	239	138
Tide water at Richmond to steam navigation on Kanawha, }	Mixed	377	1987	3366	239	138

The above is deduced from a work upon the "Laws of Trade," by C. Ellet, Jr. Esq., late Chief Engineer of this improvement.

PENNSYLVANIA ROUTE,

From tide water on the seaboard to steam boat navigation on the western waters.

TERMINI.	Character of Improvement.	Length in miles.	Height of the Alleghany summit above tide in feet.	Total Ascent and Descent in feet.	Miles of Canal.	Miles of Rail Road
Philadelphia to Columbia,	R'l. R'd	82		873		82
Columbia to Hollidaysburg,	Canal	172		748	172	
Hollidaysburg to Johnstown,	R'l. R'd	36	2491	2570		36
Johnstown to Pittsburg,	Canal	104		471	104	
Tide water at Philadelphia to steam navigation at Pittsburg	Mixed	394	2491	4662	276	118

The above information has been deduced from the reports of the Canal Commissioners of Pennsylvania,

MARYLAND ROUTE,

From tide water on the seaboard to steam boat navigation on the western waters.

TERMINI.	Character of Improvement.	Length in miles.	Height of the Alleghany summit above tide in feet.	Total Ascent and Descent in feet.	Miles of Canal.	Miles of Rail Road
Baltimore to Georgetown,	Canal	45		294	45	none
Georgetown to Pittsburg,	Canal	341	1903	3158	341	none
Tide water at Baltimore to steam navigation at Pittsburg	Simple	386	1903	3452	386	none

The above has been deduced from the reports of General Bernard and Dr. Howard.

Although it would appear from the above tables, that the Virginia route possesses a slight advantage over that of Maryland, both in distance and rise and fall, if we consider Baltimore as the terminus, still the great length and ascent of its rail road would utterly prevent a profitable competition in hea-

vy articles—and as to the Pennsylvania route, her 118 miles of rail road, her transshipments, and her small canals of 40 feet surface and 4 feet depth, combined with the great excess of lockage, will forever render it impracticable for that line to compete economically in the transportation of burden, with a continuous canal of 50 feet water line, and 5 feet depth—capable of bearing on its bosom boats freighted with 75 tons weight.

Indeed an able Civil Engineer and distinguished writer has lately urged as the only means by which Pennsylvania can render her works profitable, that she should construct a continuous canal across the mountains, even though it were necessary to pump by steam from the Conemaugh, the water requisite to feed it!

In commencing the Chesapeake and Ohio Canal upon its eastern section, it was a fatal mistake not to have begun at Cumberland, and proceeded towards the market, instead of from it; had this been done, the work with less than the present outlay would have been now finished to the "Point of Rocks," there connecting upon the one hand with the Baltimore and Ohio Rail Road, and dropping into the river by temporary locks upon the other; the minerals of Allegany could have been poured at will either into the city of Baltimore or the District of Columbia; between which last and the "Point of Rocks" a very passable navigation existed formerly by the works of the Potomac company; finished to this point, the canal, without any material prejudice to the mining interest, and with vast benefit to the finances of the state, might have rested until its revenues supplied the means of further progress,

2.—ON THE 50 MILES OF CANAL NOW UNDER CONSTRUCTION, BETWEEN CUMBERLAND AND DAM NO. 6.

In describing the canal now constructing down stream from Cumberland I shall descend the river commencing with the works at that town: and though loth to speak of what cannot now be remedied, I feel bound to declare my opinion that the plan adopted for the canal at Cumberland, is by no means as perfect as it might have been made—I refer entirely to the plan, for the various works appear to be faithfully, and I doubt not, are substantially built.

The chief mistake has been committed in adopting at the instance of a town meeting of the citizens of Cumberland, the plan usually called the "low level" in contradistinction to that of the U. S. Engineers, which has been generally denominated

the "high level;"—there is however a subordinate error in the location of the present guard lock, to which I shall hereafter refer : and it may perhaps be as well to observe that in no part of this report is it my intention to reflect upon any individual;—I merely aim to fulfil a professional duty fearlessly, and with candour.

The able engineers in the service of the United States when they planned the Chesapeake and Ohio Canal, in this vicinity, judiciously assumed a level for the canal bottom of near 30 feet higher than that now adopted upon the present or "low level." This level was maintained from Cumberland to the Narrows of the North Branch, and necessarily placed the canal line throughout this distance, nearly upon the same ground now occupied by the Baltimore and Ohio Rail Road.

The advantages offered by the "high level" are :

- 1.—By throwing the canal north of Cumberland upon a gentle side slope of which the height of the level gave perfect command, an opportunity was afforded of forming a noble basin of any desirable extent.
- 2.—The basin thus formed would have been of most convenient access to rail roads descending Wills' creek, from the mines upon its tributaries.
- 3.—The town of Cumberland would not have been placed by the works, in a worse position than formerly, in regard to freshets, and therefore would not have needed any defensive arrangements.
- 4.—The canal would not have been driven to the faces of the river bluffs as it now is, near Hoyer's mill, at Evitt's creek, and at another point, but would have passed over them with no very formidable cutting; neither would it have been thrown into dangerous proximity to the river as is now the case just below Evitt's creek, nor upon the abrupt slope of the second bottom as it is in several places; but it would have been every where above the narrows, laid upon safer, smoother, and generally upon cheaper ground.
- 5.—By cutting off the great bend, just above the narrows, it would have shortened the line near 3 miles—a matter of no small moment in competing with a rival work.

The disadvantage of the "high level," would have been its increased cost owing to a feeder being required from the north branch west of Cumberland, which however being made navi-

gable would, with the pool of its dam, have in effect improved about 9 miles of the north branch; thus carrying the navigation within 18 miles of Westernport.

A canal thus planned would as it were have embraced the mineral region—stretching with one arm near the narrows of Will's mountain, and thence receiving the minerals from the basin of Will's creek—and on the other hand advancing with its navigable feeder near enough to the mouth of George's creek, to place it within the power of the proprietors of mines in that quarter, to connect themselves with the main canal without unreasonable outlay.

The "low level" has the advantage of a less estimated cost, though the levee necessary to protect the town of Cumberland has not yet been included in the estimate.

Its intrinsic disadvantages—in addition to the inadequate command of ground which it gives below Cumberland, the insecure position into which its level compels it at several points, and its unnecessary prolongation of the line—consist of

- 1.—The insignificant extent of the basin, its water surface being but 100 feet, which will prevent boats from turning opposite where any are lying. This basin also being very inconvenient to reach by rail roads from any quarter.
- 2.—The necessity it entails of shielding the town of Cumberland from the augmented floods which the plan will produce, by constructing a long and expensive levee extending up the left bank of Will's creek.

The first objection may be partially remedied by widening the basin as much as the landholders upon its margin will permit; moreover it will perhaps be observed, and with propriety too, that the coal business ought to be, and probably will be, chiefly done as heretofore upon the left margin of the North Branch upwards from the mouth of Will's creek;—such in fact after carefully viewing the ground is my own decided opinion.* A rail road upon the right bank of Will's creek descending from the mines, could easily be conducted along the margin of the North Branch at such an elevation and horizontal distance, as to enable cars to discharge their burdens, into screening

*In the first instance however Proprietors of mines in the basin of Wills Creek will find it to their advantage, if the Baltimore and Ohio Rail Road will lay an extra track for their accommodation, to join their roads with it and pass upon that work to the small basin about $1\frac{1}{2}$ miles below Cumberland, and there make their transshipments to boats upon the canal.

shutes leading directly into canal boats lying in the pool, as is successfully and economically practised elsewhere. And this course if adopted by the parties interested in the transportation of coal, will undoubtedly, in a great degree (though not entirely,) alleviate the necessity of a more ample basin within the canal itself.

A difficulty in entering the canal from the pool of the dam, will however supervene owing to the erroneous location of the guard lock, of which I come now to speak : At the confluence of Will's Creek with the North Branch, an extensive gravel bar has been formed and the creek which formerly ran close to the face of the grand lock, now enters the North Branch some 300 feet in advance of it.

The surface of the shoal of gravel in front of the guard lock is $2\frac{1}{2}$ feet above the bottom of the canal or 26 inches higher than the top of the mitre sill;furnishing the first instance I have ever known of the sill of a guard lock being laid more than two feet under the bed of a stream whose navigation it was designed to accommodate: consequently before loaded boats can enter from the pool, with facility, a channel must be cut at least 26 inches deep in order to admit them—the question then naturally comes up, how is this channel, dug out of the river bed, to be kept open forever?—the answer would probably be, by dredging—but of this it may be observed;

- 1.—That the deposite of heavy gravel, borne by Wills' creek from the mountains, will be difficult to move in that way.
- 2.—That every heavy freshet would again close up the channel.
- 3.—That if even if dredging should prove successful, it will entail upon the canal company an annual expense forever, which ought to, and might have been, avoided.

That it was by no means necessary to locate the guard-lock at Cumberland, in a position where its usefulness will be so essentially lessened, may be rendered manifest by a few remarks:

The gravel shoal, at the mouth of Wills' creek, has accumulated simply because the transporting power possessed by the stream, in the upper parts of its course, has, at its confluence with the North Branch, become impaired or destroyed by natural causes: what these causes are, it is of no moment now to enquire. That the transporting power of the two streams will be still further reduced by the extension of the slack-water consequent upon the erection of the canal dam; and that

the obstruction in front of the guard-lock will rather increase than diminish, is a certain result flowing from fundamental principles of hydraulics.

To have evaded all these difficulties, to have placed the streams in a situation to force their own way, and keep constantly open to the face of the lock a channel of ample depth for the occupancy and transit of boats, it was only necessary to watch nature herself, and pursue her indications.

The outline of the gravel at low water, marked the proper situation for the canal bank, and near the extreme point of the shoal, some two hundred feet in front of its present position, properly directed towards the pool, and with its upper mitre sill laid adjacent to deep water, the guard lock ought to have been located. The guard bank of the canal should have pursued the outer margin of the gravel bar, being armed externally with a heavy riprap of imperishable materials, and showing to both streams a slope of about $2\frac{1}{2}$ to 1. The shoal itself, under this arrangement, would have been comprised within the canal basin, materially and economically extending its capacity.

Thus, at but little more expense than has already been incurred, the basin would have been enlarged, the guard lock made available, and the use of the dredging machine avoided, by contracting the streams so as to restore their transporting power, and enable nature to do that work.

It is true that this plan would have caused an increased rise of water in freshets. Such in effect would have been its design; but as I have heretofore declared the formation of an ample levee to be *incident* to the "low level," and *indispensable* to the security of the town, a small additional rise in the streams would have been of no moment to a place thus shielded against floods.

It is indeed still possible to remedy, in a degree, the defective location of the guard lock, though not without considerable expense. The plan would be to close the present mouth of Wills' creek by a causeway elevated above the freshets; to embank the greater part of the gravel shoal to the same height; (affording a noble site for a warehouse;) to cut open a new channel for the creek, passing the face of the guard lock, and thus limiting both it and the North Branch to such a width of water way, as would guarantee a sufficient accession of velocity during freshets to keep their channels clear.

I will now state the reasons why, in my opinion, the town

of Cumberland will require a levee to shield it against the probable augmented height of freshets; which augmentation will be produced by the works of the 'low level.'

Previous to commencing the works at Cumberland, the ordinary summer level of the water at the mouth of Wills' creek, was, in the pool of the old dam, about $2\frac{1}{2}$ feet above the present bottom of the canal. The comb of the canal dam will be elevated $6\frac{1}{2}$ feet above bottom; thus producing a perpendicular rise, upon the old water surface, of 4 feet at low water.

Without entering into any disquisition upon the peculiar profile assumed by the pools of dams in freshets, or the measure of the increased height which floods in rapid streams invariably assume at the head of a slack water pool, I will venture to express the belief that the augmented rise of freshets at Cumberland, (to say nothing of the probable gorging of ice in the pool of the new dam, the effect of which none can estimate,) will not be much less than the four feet by which the old surface will be elevated.

Again, the extensive flat below Cumberland, and extending to Hoyer's Mill, generally known as the "island," over which formerly the river always spread itself in extreme freshets, obtaining, on such occasions, a high water channel of near 800 feet broad, is now excluded from overflow by the guard bank of the canal, which will never be overtopped.

Taking, then, these two facts into connection,

1. An absolute elevation of the water surface at the place, to the extent of four feet perpendicular;—

2. An absolute contraction of the high water channel of the river nearly one half, and it occurs to me that the works of the "low level" will place the river in a worse position than it occupied during the freshet of 1810, which swept through the town several feet in depth. On that occasion, if I am correctly informed, the "island" was covered with standing timber, against which an immense mass of drift lodged, and occluded the river, (though less effectually than the canal bank will do hereafter.) Now, if that freshet thus dammed out of the "island," had been borne up by a substratum of water four feet higher, would not the result have been more disastrous? would not both property and life in Cumberland have been periled then? Those who witnessed that flood, can answer best; but from the statements made to me, I should anticipate affirmative replies to both questions.

If the canal should be put in operation, without construct-

ing the level referred to, a high guard gate will be required at the commencement of the side hill section below Hoyer's mill, in order to prevent the river, which in freshets, will undoubtedly pass around the present upper end of the guard bank and enter the basin, from rushing through and destroying the canal below. Indeed, as a measure of due precaution, this guard gate ought, in any event to be built, to avoid effectually the serious injuries which would result in a high freshet from a sudden breach, either in the canal, guard bank, or in the contemplated levee. Before concluding this subject, I will observe that, with the canal dam upon its present site, (a few hundred feet below the mouth of Wills' creek,) the augmentation of freshets will be much less than would have been the case if the dam on the same level had been built a mile below the town, as was formerly proposed: and hence the change in its location, made by my predecessor, was most judiciously designed to keep down that augmentation to the lowest possible limit.

Having now, as briefly as possible, touched upon most of the questions which have presented themselves in connection with the plan of the works at Cumberland, I shall proceed to a succinct description of the line and its condition.

The surface of the canal, in the basin at Cumberland, is about 600 feet above tide, being attained by 75 locks, averaging near 8 feet lift each. The canal then, between Georgetown and Cumberland, is composed of 75 different levels, of various lengths; the 75th level extending into the latter place, and forming the basin referred to.

The guard lock and flume feeder at the Cumberland dam are just finished, and the dam itself is raised within 7 feet of its intended height; the paving, riprapping, and nearly all the work under water, having been happily completed during the past season. The bailing was done this year by an Archimedes screw, turned by a small high pressure steam engine, proving an immense saving, compared with the charge of draining the foundations in 1839.

The 75th Level is 8 miles and 4282 feet in length; leaving the Cumberland basin it passes along the face of a river bluff below Hoyer's Mill, and then entering upon favorable ground encounters no important obstacle until in approaching Evitt's Creek it is again forced to pass along the face of a cliff: At Evitts Creek it crosses Aqueduct No. 11. of 70 feet span and 14

feet rise, which is just finished, and passing the valley of the stream by a considerable embankment, it extends for about a mile close to the margin of the river and upon very precarious ground, when after running in front of another cliff it enters upon a second bottom, either upon which or on its abrupt front slope it continues around the Great Bend to Lock No. 75, the ground being generally favorable: both the Earth Work and the Masonry upon this level are far advanced towards completion: there is some unnecessary curvature on this part of the canal which it is too late to remedy. By Lock No. 75 of 10 feet lift, now very nearly finished, we descend to the 74th level which is quite short, being only 850 feet in length; both the earth work and masonry upon this level are almost completed.

By lock No. 74 of 10 feet lift, now almost finished, we drop down to the 73rd level, which is also short, being 579 feet in length, and upon which both the earth work and Masonry is finished or nearly so; it is upon this Level that the Baltimore and Ohio Rail Road by a noble viaduct will cross both the river and the canal.

By Lock No. 73 of 9 feet lift, now nearly done, we descend to the 72nd Level which extends through the narrows of the North Branch and is 1 mile and 145 feet in length; upon it the earth work and masonry are both nearly finished; a culvert has been designed near the middle of this level which may be dispensed with without prejudice to the work, merely forming across the ravine above the canal a dike of large rock, to answer at once the double purpose of catching any wash that may come down, and also of carrying the county road over the ravine, in lieu of an insecure bridge now erected there; the location of this level is rather defective but cannot now be remedied. Such is the advanced state of the several works upon these four levels, the 72nd, 73rd, 74th and 75th, whose aggregate length is 10 miles and 576 feet, that if the unfinished parts were vigorously taken in hand in March next, the navigation might be opened through all these levels in October of next year or at the farthest could be made ready for the earliest navigation of 1842; and by a temporary wooden lock below lock No. 72, the coal boats from Cumberland could be passed out into the river $10\frac{1}{4}$ miles below that Town.

Some such arrangement would seem necessary next year as the Cumberland dam will be finished and will almost entirely close the river against the trade of the upper Potomac.

By lock No. 72 of 9 feet lift at the foot of the narrows,

which is now just finished, we descend to the 71st level the length of which is 6 miles and 4867 feet; it extends from the narrows to Oldtown, and upon it all the heaviest earth works, including the deep rock cutting at Cresap's Mill, are finished or nearly so: The earth works not yet begun of which there is a considerable length, are all bottom land sections presenting no unusual difficulties; no masonry of any kind has yet been done on this level.

By lock No 71 of 8 feet lift located opposite to Oldtown in the vale back of Alum Hill, which is attained by the canal through the deep cut at Cresap's, and of which lock the masonry is not yet begun, we drop down to the 70th level, which is a short one, 1708 feet in length, and upon it nothing has yet been done.

By lock No. 70 of 8 feet lift, of which no masonry is commenced, we descend to the 69th level, which is 1405 feet long, and upon which nothing has been done: over the tail of lock No. 70. a bridge will be required to pass the Oldtown and Springfield road which here crosses the canal.

By lock No. 69 of 8 feet lift, and of which no masonry is laid, we descend to the 68th level.

These three locks No. 69, 70, and 71, overcoming together 24 feet of lockage, are in a very backward state, the pit of one only being partially excavated and a very few stones prepared: at the usual rate of working upon this canal, it will require near 50 months to prepare these works for the admission of navigable water.

The 68th level is 1 mile and 5052 feet in length, and extends from Oldtown—passing the bluff above the forks of Potomac, called Rock Difficult—terminating in the Ferry road opposite to the mouth of the South Branch, neither earthwork nor masonry has been done upon this level, except at the bluff, the canal around which is nearly formed.

A reconnoissance of the ground, induces me to regard the location of the canal upon the 68th level as defective; between Oldtown and the Bluff it pursues a circuitous course, and for part of the distance lays along the brink of the river on insecure ground. No work having been done upon this part of the level, it is happily yet in our power to alter the line if an instrumental examination should prove it to be advisable. This alteration would consist in moving lock No. 69 down from Oldtown to the upstream end of Rock Difficult, pursuing with the canal, between these points a safer and more direct route, sev-

eral hundred feet further removed from the river; it would also appear that by a heavy back drain we could upon the altered line save the construction of a culvert. I therefore respectfully advise that before letting this part of the work a proper survey may be ordered to determine whether or not these anticipated advantages can be realized.

By lock No. 68 of 8.258 feet lift, located in the South Branch ferry road, and to which nothing has yet been done, we descend to the 67th level. Over lock No. 68 the canal company have bound themselves to build and maintain a bridge. The 67th level which is 3 miles and 702 feet in length, extends from the mouth of the South Branch to about 3-4 of a mile below Town creek, over which stream it will pass upon Aqueduct No. 10 of 60 feet span and 15 feet rise, of which one abutment only has been founded: to complete this Aqueduct, its entrance walls, and adjacent embankment will require 30 months, at the usual rate of working. Upon this level one section and part of another is finished, the earth work remaining to be done, being bottom land sections, somewhat heavier than usual. The masonry upon this level is in a very backward state.

It is upon the two last mentioned levels that it has been proposed to bring in feeders; upon the 68th, by an Aqueduct from the South Branch, and upon the 67th, either by a feeder dam erected on the town falls, just below the mouth of the South Branch, as was proposed by the U. S. Engineers, or by a reservoir formed upon Town creek, as might be preferred: of all which plans I shall hereafter speak, when treating of feeders, after describing the entire line.

By lock No. 67 of 8 feet lift, to which but little has been done, we descend to the 66th level, which extends from 3-4 of a mile below Town creek, entirely through the tunnel, and is 7 miles and 515 feet in length. Upon this level then are a number of earth works of the very heaviest character, all of which however, with two exceptions, are finished or nearly so, and the sections which remain untouched are located in bottom land of a favorable character. The formidable deep cut through Mitchel's Neck, just above the tunnel, is now being trimmed off, having been brought to completion by the experienced contractor, to whom it was allotted, in a most energetic and satisfactory manner. The excavation of the extensive tunnel upon this level, at the Pawpaw Bend, is well advanced, and if it did not require arching throughout, this work could soon be finished; adjacent to the southern or up-stream portal, I propose to alter the present location of the canal, by throwing out a re-

versed curve in the line near the entrance, and causing it to lead into the tunnel upon the prolongation of the tangent which forms its axis; this alteration at a small increased cost will beautify the route, and producing a saving of 20 degrees of curvature, will be an essential improvement.

This tunnel is 3118 feet long, and its transverse section of excavation 27 feet wide by $25\frac{1}{2}$ feet high, the sides being cut plumb, the top a semi-circle, and a solid tow path of rock being left in; when completed the arch will necessarily contract its dimensions, and it will then have, a water way of 19 feet wide, and 7 feet maximum depth, furnishing a greater water section than the Aqueducts now in use, a solid tow path of 5 feet clear width, guarded by a brick parapet, and the soffit of the arch at the crown will be 17 feet above the water line of the canal—thus offering a convenient and ample navigation for the transit of single boats or boats in a single line.

The excavation hewn throughout its course from the solid rock, has been carried on by means of two sets of working shafts, wrought by horse gins, the shafts being 188 and 122 ft. deep respectively; and also by open drift from the south portal, where the excavated materials were carried out upon a rail road laid on the tunnel bottom, and thrown away as spoil bank in the river.

The excavation has been uniformly advanced by blasting in two breasts, first, the *heading*, being a cut of $12\frac{1}{2}$ feet high next to the crown of the tunnel; and second, the *bottoming*, being a thorough cut of 13 feet deep, extending from the floor of the *heading* to bottom of canal, or rather to the bottom of the tunnel which is one foot below.

Upon the 5th day of June 1840, the *heading*, which by day and night (Sundays excepted) had been wrought without intermission, since June 1837, was completed and opened by effecting a junction between the working proceeding north from the southern portal, and that driving south from the deep working shafts; the other shaft workings having been finished in the year 1839.

This junction took place at a point 1503 feet inward from the south portal, and 340 feet deep, beneath the surface of the ground. Upon clearing the way for the instruments of the Engineer, it was found that all the lines and levels previously given in the several workings, under all the disadvantages caused by a transfer of levels down the shafts, by the smoke

of powder and by the darkness, verified and coincided with extraordinary precision, whilst the meeting of the workings was exact.

Very little trouble has been experienced in ventilating the workings of this tunnel; no artificial means having ever been either needed or resorted to, except an occasional fire at the feet of the shafts, or in their man holes. The working shafts having been sunk in pairs, 15 feet clear apart, and joined by suitable man holes. There was never any difficulty in producing a circulation of air by the aid of fire, or in directing the pneumatic current at will, either up or down a particular shaft. And so pure was the air in the *heading*, at 1500 feet in from the south or open portal, where no air shaft or artificial ventilation was ever required, that I entertain not the least doubt that a tunnel of the dimensions of this one, might be driven in such material, from an open portal, near half a mile under ground, without other ventilation than would be produced by the natural currents of air from the open end.—The British miners, in their coal workings, regard 300 yards lineal as the maximum length to be given to drifts without air shafts; but experience here indicates that, in works of this size, penetrating a material, which engenders no deleterious gas, 500 yards lineal, may be driven with entire safety, and perhaps even far exceeded.

In November, 1839, when the two main workings had approximated within 600 feet of each other, and were, respectively, 525 and 510 feet deep under ground, the sound of the blasts in both workings was reciprocally heard in each, through the intervening mass of solid rock, resembling a dull tap with a hammer; and when they had attained a distance of 150 feet apart, the sound of the advancing hammers of the miners could be heard through.

The drainage of this tunnel has never been very great, not having, at any time, exceeded an average of *four* cubic feet of water per minute.

As but 1,502 feet lineal of the full section of *bottoming* now remains to be done, the tunnel excavation is in such a state of progress that, by pressing it vigorously, there would be no difficulty in bringing it alone to completion in 18 months; and inasmuch as the arching could and ought to be commenced before the excavation is all removed, (because the packing behind and over the arch is to be supplied by the spoil of the *bottoming*,) if the manufacture of brick, which has been too

long delayed, was promptly commenced, the arch and tow path could be finished, and the tunnel thrown open to the navigation within 30 months.

It was long hoped that arching this work might either be dispensed with entirely, or at the most, that a short arch at the portals would be sufficient; but such is the character of the material, the absence of coherence between the strata, and so extensive the falls of rock from the roof, which are continually taking place, that having carefully watched this work from its very inception, I have come to the decided conviction that a thorough arch is indispensable to the safe and uninterrupted transit of boats.

As it has been imagined by some that the arching would require a long time, it may be as well to give an outline of the plan upon which I have long contemplated proceeding with this portion of the work, and by the execution of which I have entire confidence that, with a heavy force, this formidable arch, though 3,118 feet long, and requiring about three and a half millions of bricks, can be constructed in a single year: the bricks being prepared before hand and delivered at the portals.

By the experiment, of Col. Pasley, of the Royal Engineers, of Mr. Brunel and others, the cohesive power of cement has been demonstrated to be so great, that from 20 to 30 bricks, with their longest dimension vertical, have been stuck out horizontally from a wall, by adding successively a brick at a time as soon as the cement joint of the preceding one had set.

Acting upon the principle of cohesiveness here developed, possessed, as it is in an eminent degree by the hydraulic cement of the Potomac, which I contemplate using in the arch at least, without any admixture of sand, in order to procure a quicker set and firmer bond, I propose,

1—With a strong force, to raise both side walls up to the springing line of the arch.

2—In sections of, say 500 feet, by reverse moulds and without centring, to carry up the arch on both sides to the angle of repose, and bringing into play the coherence of the cement, even above it, say to an angle of 40 or even 45 degrees, as may be determined at the time.

3—By a system of detached centres, framed to leave open about 30 degrees of the crown, each supporting three feet lineal of the arch, and leaving an interval of four or more feet to be sustained by the cohesive power of the cement, to

carry up the spandrels of the arch to an angle of 75 degrees or within 15 degrees of the crown on each side.

4—By a very light centre, (capable of being handled by two men,) to key up the crown in sections of 2 feet, shifting the crown centre continually, (upon a platform carried by the detached system,) as each successive section of the crown is keyed up and packed.

Those who are conversant with practical affairs, will at once perceive that, by working in long sections, course by course successively, the cement will set in one part whilst the workmen are engaged at another; and that by the division of labor indicated in the above outline, a very large force can be employed upon the arch, and so organized as to finish each part in detail; the most tedious portion, that of keying up, being limited, by the mode of operation, to 30 degrees of the crown alone, or but one-sixth of the semi-circle, can be advanced by working only from a single point, at the rate of 10 feet lineal per day.

Some curiosity having been expressed with regard to the probable detention at, and the mode of transit through the tunnel, I propose, before dismissing this subject, to dwell briefly upon both.

The canal for some distance both in approaching and leaving the tunnel, has from economical considerations been planned with a single boatway, as follows :

	<i>Feet,</i>
Canal contracted to a single boatway adjacent to the south portal,	200
Tunnel, (in length)	3118
Canal contracted to a single boatway adjacent to the north portal,	894

Total length of canal contracted to a single boatway, 4212

The speed of loaded boats upon canals is usually taken at $2\frac{1}{2}$ miles per hour, and this may be considered as the maximum pace of fully freighted boats. Owing to the contraction of the water way and other causes, in the tunnel, the progress of boats in their transit through will be slower than upon the open canal, and will not probably exceed the rate of $2\frac{1}{4}$ miles per hour or 198 feet per minute.

A single passage through a lock of 8 feet left may be practically regarded as requiring upon an average 5 minutes, and an alternate or cross passage of two boats 10 minutes.

Hence with single locks (which case only I shall here consider) if the canal were working at its utmost capacity, it would upon the supposition of uniform motion, bear upon its bosom during the season of trade, an ascending and a descending procession of boats moving at intervals of 10 minutes apart, passing each other alternately, and locking in alternation: consequently 12 boats, or 6 proceeding in each direction, would pass a fixed point during every hour.

Having thus premised I will observe that it is so evident that in order to save time boats must pass the tunnel in convoys of several, that it is unnecessary to establish that fact by calculation; the only question is how many boats ought each convoy to consist of when the canal is working at its maximum rate with single locks, and consequently when boats are successively arriving at both portals, at intervals of 10 minutes apart?

The answer is—that the proper number will depend directly upon the time requisite to move twice through the contracted canal and draw out past a waiting convoy, or in fact directly upon double the length of the single boatway and convoy in waiting.

For the sake of brevity, I will assume the length necessary to accommodate a waiting convoy at 1200 feet, then as this convoy by lying along the beam side, would contract the canal to a single boatway for that distance, we shall have :

	<i>Feet.</i>
Length of tunnel and canal contracted to a single boatway,	4212
Length of convoy in waiting (and also contracting the canal)	1200
	<hr/>
Total length of single boatway in effect,	5412

Now to traverse 5412 feet, *twice*, or 10824 feet, at our assumed pace of $2\frac{1}{4}$ miles per hour or 198 feet per minute would require 55 minutes, and allowing 5 minutes for starting the convoys at both ends and for lost time, we shall have as the period occupied in a double transit, 60 minutes.

To prevent meeting, evidently no boats can be permitted to enter either portal from the moment a convoy in one direction leaves, until the returning one moving in the other, has drawn out of the tunnel; hence if we imagine a boat to arrive at one portal the instant a convoy has departed, she would be compelled to wait 60 minutes before her time for passage as the lead-

er of the next convoy would arrive; during this space of time 6 boats would collect, and that is the proper maximum number for a convoy, to pass this tunnel upon the hypothesis assumed.

If the canal had double locks the convoy should consist of 11 or 12 boats and the passages still be hourly. Boats then ought to be passed through this tunnel both ways *at every hour*, and with an active trade it would be necessary to have a superintendent stationed at each portal to regulate the hourly transits, and perhaps also to provide gates or some other barrier under his control, to be opened *hourly* to admit the entrance and exit of convoys.

The hours fixed for the transit of convoys both ways should be regularly notified to the boatmen in print—thus :

Descending convoys will leave the south portal of the tunnel at
8 A. M.; 9 A. M.; 10 A. M.; &c.

Ascending convoys will leave the north portal of the tunnel at
8½ A. M.; 9½ A. M.; 10½ A. M.; &c.

All boats presenting themselves for passage, to conform strictly to the instructions of the tunnel superintendents, and haul into such positions as they may indicate. If boats should arrive at either portal, when no convoy was forming at the other, and no boats thence in sight, a system of signals could easily be concerted to communicate that fact, and the arriving boat in such case, be allowed by the superintendent to proceed without any delay.

It is evident from what has been said that the utmost detention that any boat can experience will be 60 minutes, whilst a boat arriving just as a convoy, in the same direction was setting out, would join its rear and not be detained at all; hence the average detention may be assumed at thirty minutes, which enables us to ascertain the real or effective saving in distance caused by the adoption of the tunnel route for the canal, in lieu of that located around the Pawpaw Bends.

	<i>Miles.</i>
A canal around the Pawpaw Bends would be in length,	6½
The tunnel line (including cuts, &c.) is, to the same points,	1½
	—
The saving in measured distance being,	5

Now during the 30 minutes average detention, a boat proceeding at the rate of 2½ miles per hour, would move upon the

open canal $1\frac{1}{4}$ miles, therefore the virtual saving of distance produced by the tunnel route, when equated by the average loss of time is, 5 miles minus $1\frac{1}{4}$ miles or $3\frac{3}{4}$ miles* saved in effect.

Such are the theoretical results upon a fixed hypothesis, that establish the limits of this subject, which of course in practice will be modified by many causes; and I will now dismiss the matter with the observation, that though the deductions in this connexion, might be both more briefly and vigorously developed by mathematical formula, yet I have preferred the more familiar explanations given above as best suited to the present purpose.

The drawings, I have sketched to accompany this report, and elucidate the condition of affairs at the tunnel, such will be found at the end, are

Fig. 1. Exhibiting a longitudinal section displaying the present state of the tunnel excavation.

Fig. 2. Exhibiting a section of the finished excavation of the tunnel.

Fig. 3. Exhibiting the tunnel with its arch and tow-path complete.

In the heavy deep cut in "Athy's hollow," adjoining the northern portal of the tunnel some very formidable slides of rock have occurred within the past year, and others are threatened which will enhance both the cost and difficulty of this part of the work.

The 66th level terminates at the lower end of this cut and in the ravine called "Athy's hollow" into which it opens, are located four locks of 10 feet lift each, separated by pools of 30 feet surface and 400 feet clear length; by this 40 feet of lockage in a distance of 1638 feet we descend to the 61st level, upon which it has been proposed to introduce a feeder which I shall notice hereafter.

The 40 feet of lockage in "Athy's Hollow," to which nothing has yet been done, is the heaviest and most backward masonry upon the line, or that which will require the longest time to complete it. These locks are attended with several difficulties: suitable stone is difficult of access; the quarry will be remote from the work; the ravine, in which the locks are located, is so narrow, as to furnish very little room for a stone

*Strictly the virtual saving would be a little less, owing to the greater speed upon the open canal

yard; the earth work at the mouth of the hollow will interrupt the road; the drainage of the ravine must be provided for during the construction; the locks must be puddled and embanked in this contracted place; the rail road on the tunnel spoil bank must remain uninterrupted, and the materials for each lock must be hauled over the site of the one below. All these things present obstacles which will enhance the time of completion; and will, I apprehend, cause them, at the ordinary rate of progress to require 30 months from the time they are placed in the hands of an experienced and responsible contractor, before they and their dependent works can be thrown open to the navigation.

The President of the Company has thrown out a valuable suggestion in connection with these locks: it is whether it would not be advisable to overcome the 40 feet of lockage by one, or at most by two locks of high lift, as is practised upon the Lehigh navigation, and for which the character of the ground certainly offers unusual advantages.

If any such plan were adopted, it would perhaps be best to locate one lock of 10 feet lift upon the present site of lock No. 66, and throw the rest of the lockage into a single lift of 30 feet, located about a quarter of a mile below: this would enable the surplus lockage water to waste off at once over the wier upon the 61st level, at the mouth of "Athy's Hollow," and thus prevent any interference with the regular feeding to the lower levels.

This lock, of 30 feet lift, would of course supply the place of three locks each of 10 feet lift, and the first question is would it cost more?

The quantity of masonry in locks being dependant upon their lift, length of chamber, and depth of canal water, and the locks of the Lehigh navigation having the same length of chamber as those of this line, and nearly the same canal depth: hence stone locks, of the same lift, on these two works, ought to contain nearly the same amount of masonry.

The largest lock upon the upper section of the Lehigh navigation being of 30 feet lift, is thus described by the Commission of Inspection, appointed by the Governor of Pennsylvania, in their report to him, dated June 12th, 1838:

"The dimensions of the largest of the locks, (No. 27, called *Pennsylvania lock*,) being as follows: 27 feet thickness of solid wall at the bottom, and 10 feet on the top; 30 feet lift, 3 feet working guard, chamber of 20 feet in width and 100 feet

in length, 86 feet clear of the swing of the gates, and containing 9,972 cubic yards of masonry, and 242,419 feet board measure of timber work."

One lock then of 30 feet lift in "Anthony's Hollow," if built on the same plan as those of the Lehigh, would contain 9,972 cubic yards, or 10,769 perches of masonry: now, as 3 locks of 10 feet lift each, upon the plan hitherto proposed, would only contain in all 4,050 perches, it would seem that 6,719 perches of masonry would be saved by adhering to the 10 feet lifts.

Still, as owing to peculiar circumstances, the "Pennsylvania lock" may be built much heavier than would be requisite, if of the species of work in use here, (to which opinion I incline.) and as in consequence of the ingenious arrangements employed to fill and empty this lock, but six minutes is needed to pass a boat through it, being nearly the same time usually consumed in a transit through one of our 10 feet lifts. I cannot avoid regarding the suggestion of the President as being of such importance, that previous to letting out these locks, I would respectfully advise the Directors to cause their Engineer to examine the works upon the Lehigh, the only place in the world where such high lift locks have been brought into successful use, and report at length upon their merits and defects.

The 61st level, leading out of "Athy's Hollow," is 1 mile and 1,916 feet in length, about $\frac{3}{4}$ of a mile of which is heavy hill side work, the rest being easy bottom land. Nearly all the earth work but no masonry has been done upon this level.

By lock No. 61. of 8 feet lift, and yet untouched, we descend to the 60th level, on which no masonry has been done, and whose length is 3 miles and 1,807 feet. Just below lock No. 61 it enters upon a heavy hill side, of a mile in length, along which the earth work is far advanced towards completion. Leaving the hill side, this level enters the "7 Mile Bottom," and continues through easy ground, yet unbroken, to near the middle part of that bottom.

By lock No. 60, of 8 feet lift, of which no masonry is laid, we descend to the 59th level, whose length is 3 miles and 681 feet, and upon it some little masonry has been done at a culvert. This level lies entirely upon the favorable ground presented by the surface of the "7 Mile Bottom;" no earth work

has been done upon it, and it terminates about half a mile above the lower end of the bottom.

By lock No. 59, of 8 feet lift, to which nothing has been done, we descend to the 58th level, whose length is 2 miles and 2,524 feet. This level, leaving the "7 Mile Bottom," lays along a side hill for near two miles, and then ends in a narrow bottom land. All of the heavy earth work, but no masonry whatever, has been completed upon this level.

By lock No. 58, of 8 feet lift, which is scarcely begun, we drop down to the 57th level, which is 4 miles and 3,562 feet in length, and extending entirely around the bend of the river, opposite to Orleans. It crosses 15 Mile Creek, by aqueduct No. 9, of 50 feet span and 10 feet rise, which is ready to receive its arch, the skewbacks having recently been set. Leaving 15 Mile Creek, this level, generally tracing the foot of a side hill, extends to the head of the pool of dam No. 6. There are a number of hill side earth works upon it, all of which are finished, or nearly so, bringing this part of the line almost to completion. Trifling depths of water have produced leaks upon this level, which indicate serious weakness; it should therefore be narrowly watched, whenever the navigation is opened upon it.

By lock No. 57, of 8 feet lift, which is now finished, we descend to the 56th level, at the head of the pool of dam No. 6. This level is 2 miles and 5,264 feet in length, and extending first through a favorable bottom, (where the tow path being within the reach of high water, it is contemplated to elevate it;) it next stretches along the base of a formidable hill side, and reaching sideling Hill creek, crosses over it by the finished aqueduct No. 8, of 60 feet span and 12 feet rise, and ultimately terminates in a narrow flat, about $\frac{1}{2}$ mile below the aqueduct.

Owing to the weakness of the plan of riprap, the height of the levels above the river, the depth of water at the foot of the external slope, and the augmented rise of the freshets, caused by the pool, there are *two* sidehill sections upon the 67th, and *four* upon the 56th level, which require additional security; this I would propose to give, by forming along the foot of the river slope a dike of rock, 15 feet wide, its top elevated about 6 feet above low water, and its external slope not steeper than $1\frac{1}{2}$ to 1, and composed of heavy and durable stone.

Upon the level, 56th for $\frac{3}{4}$ of a mile below lock No. 57, the tow-path has been unnecessarily laid broad off from the hill,

passing for some distance so dangerously near to the brink of the river bank, that about 500 feet lineal, of a suitable river dike and riprapi, will be required to secure it before the navigation can be safely maintained upon this level.

By lock No. 56, near $\frac{1}{2}$ mile below Sideling Hill creek, with a lift of 7.7-10 feet and which is fairly begun, we descend to the 56th level, which is 2 miles and 789 feet in length. and extends along the pool, through generally favorable ground to dam No. 6: most of the masonry, and some of the earth work upon this level is finished.

By lock No. 55, of 7.8-10 feet lift, which opens through the grand wall of dam No. 6. and which is just finished, we descend to the 54th level, which passing the end of Tonoloway Hill, is about 600 feet long.

By lock No. 54, of 7.8-10 feet lift, we descend to the 53d level, which is that of dam No. 6.

This lock No. 54, to which but little has been done, terminates the unfinished 50 miles, now under construction below Cumberland.

Summary of the Locks and Levels on the 50 Miles.

No. of Level below Cum- berland.	No. of Lock and level a- bove George Town.	Lift of Lock.	Length of Level.		REMARKS.	
		Feet.	Miles.	Feet.		
1	75	10	8	4282	From the 75th to the 72d Level inclusive, the chief part of the Masonry is now finished.	
2	74	10	0	850		
3	73	9	0	579		
4	72	9	1	145		
5	71	8	6	4867		
6	70	8	0	1708	From the 71st to the 58th Level inclusive, the Ma- sonry is exceedingly back- ward, being in fact scarce- ly begun.	
7	69	8	0	1405		
8	68	8.258	1	3052		
9	67	8	3	702		
10	66	now conver- ted into 4 Locks each of 10 ft.=40 Lockage	7	513		
11	65		0	1638		
12	64					
13	63					
14	62		1	1916		
15	61	8				
16	60	8				
17	59	8				
18	58	8	3	681	From the 57th to the 54th Level inclusive, the Ma- sonry is well advanced, and the most of it is now finished	
19	57	8	2	2524		
20	56	8	4	3562		
21	55	7.7	2	5264		
22	54	7.8	2	789		
		7.8	0	600		
Total Lift and Length.		181.558	49	5204	Distance 50 Miles nearly.	

All the heavy river and sidehill sections, are now either finished, or so far forward, that a few months will suffice for their completion; they are, in point of fact, much further advanced at this time, than the light, bottom-land sections heretofore left untouched. It is the masonry and the earth works, dependant on its execution, which will detain the opening of the navigation. Indeed, with the exception of

1. The 24 feet of lockage at Oldtown, in three locks.
2. The aqueduct No. 10, (over Town Creek) and its dependencies.

3. The tunnel, and its arch and tow-path.

4. The 40 feet of lockage, in "Athy's Hollow," in four locks.

There is no work of any kind remaining to be done upon the line, which needs, necessarily, more than 18 months time to finish, and the $10\frac{1}{4}$ miles next below Cumberland, can, as I have before stated, be opened in less than one year.

Although I have declared, and now repeat, that at *the usual rate of working*, 30 months would be required to finish these four jobs, and the dependant earth works, yet if the company were possessed of ample ready means, I should not despair,—by letting to the contractor of each, all the adjacent earth works necessary to be done in connection, and by vigorously directing a powerful force upon all these backward contracts—of pushing them through, within the space of *two years*, from the time of contracting with experienced and responsible men, for the completion of those not now let, and also of their dependant work.

After the 1st of January, 1841, there will not be more than a dozen works under construction upon the line, and were these all contiguous, a single engineer party of three persons, could very easily superintend them: but being scattered as they are, over an extent of 50 miles, it will scarcely be practicable, during their progress, to dispense with either of the *two* parties of three persons each, which are now retained in the service.

So material has been the reduction made within the last 18 months, both in the number and expense of the officers engaged in the construction of the canal, that I have embodied in one view for the information of the directors a tabular statement of the number of persons in employ at different periods under the orders of the engineer in chief, and of their annual pay; and to make the lists complete I have annexed the commissioner as being connected with the construction.

TABLE OF OFFICERS.

RANK.	In employ, July 1, 1839		In employ, Feb. 1, 1840		In employ, Oct. 1, 1840		In employ, Jan. 1, 1840	
	No.	Annual Pay.	No.	Ann'l Pay.	No.	Ann'l Pay	No.	Annual Pay.
Commissioner, - - -	1	\$2000	1	\$1000	1	\$1000	1	\$1000
Chief Engineer, - - -	1	5000	1	4000	1	4000	1	4000
Principal Assistants, - - -	4	8000	2	4000	none		none	
Assistant Engineers, - - -	6	6600	4	4800	2	2400	2	2400
Draughtsman, - - - -	1	1277 50	none		none		none	
Rodmen, - - - -	7	4200	4	2160	2	1080	2	1080
Volunteer Rodmen, - - -	5	1800	none		none		none	
Chain and Axemen, - - -	13	4750	4	1460	2	730	2	730
Chief Sup. of Masoury, -	1	1800	none		none		none	
Assist. Sup. of Masonry,	7	4770 50	2	1363	2	1363	none	
Section Inspectors, - - -	9	5110	5	2920	4	2190	none	
Totals,	55	45308 00	23	21703	14	12763	8	9210

One of the rodmen acted as clerk to the chief engineer until Oct. 1st 1840, when that office was abolished, he also acted for a short time as commissioner; and since Oct. 1840, the chief engineer is required to do the duties of chief engineer, principal assistant engineer, and clerk, these three offices having been merged in one.

So far have the works upon your canal now advanced towards completion, that it must be a source of sincere satisfaction to all who are really interested in its welfare, to know that the cumbrous and expensive corps of engineers and superintendents formerly upon the construction, *will never again be necessary.*

For the information of the directors, whenever they may place under contract all their unfinished work, I have laid in the subjoined table, an organization of officers for superintendence, which, supposing a due degree of industry on the part of the several individuals—experience upon the line, and a perfect knowledge, of the present condition and future wants of every work, enables me to pronounce with confidence, *amply sufficient* for a vigorous and efficient supervision of all the work yet to be done.

Organization for the final completion of the Canal.

No of the Party	RANK OF THE OFFICERS.	Pay per Annum.
1	1 Commissioner,	\$1000
	1 Chief Engineer,	4000
	1 Assistant Engineer,	1200
	1 Rodman,	540
	1 Axeman,	365
2	1 Inspector of Masonry and Sections,	730
	1 Assistant Engineer,	1200
	1 Rodman.	540
	1 Axeman,	365
	1 Inspector of Masonry and Sections,	730
3	1 Assistant Engineer,	1200
	1 Rodman,	540
	1 Axeman,	365
	1 Inspector of Masonry and Sections,	730
Total number of Officers, 14, at		\$12505

1 commissioner, 1 chief engineer, 3 assistant engineers, 3 rodmen, 3 axemen, and 3 inspectors of masonry and sections, 14 in all; the chief engineer to have his office at Cumberland, and to execute upon the line the duties of principal assistant as well as engineer in chief.

The 1st party to be stationed at Oldtown.

The 2nd party at the tunnel.

The 3rd party at 15 mile creek.

Those several points being convenient to the mass of work to be done.

All the persons attached to a party to be under the control of the respective assistant engineers, and they of course, to be responsible to the chief engineer, for the due performance of their duties.

An unusually heavy freshet in February 1840, demonstrated a fact, before sufficiently apparent, viz : That the riprap protections with which the sidehill sections have been armed against the river, are generally between Dam No. 6 and Cumberland, entirely too light; unfortunately too the rock furnished by the cuttings and used in the Riprap at numerous points is so perishable, as to place it beyond doubt that most of these river protections will require—indeed some now need extensive repairs : these renewals ought as a matter of course to be made with durable rock.

This freshet also clearly indicated how judicious it was in my predecessor, to cause the canal levels along the river to be laid so high—so unnecessarily high as some thought—above low water mark, for the mingled ice and water which filled the river upon that occasion, rose in many places within a few feet of the top of the tow path, and in fact at two points actually overflowed it; at both these points steps have since been taken to guard against the future entrance of the river, during floods.

I now propose to dwell upon the *uniform depth of water* proper to be maintained in the canal whenever the navigation shall be opened from Georgetown to Cumberland.

The 16th section of the charter fixes the minimum depth at "*four feet*" and having cursorily examined the legislative acts referring to this company, I can find no further allusion to the depth of water, except in the act of Congress of May 24th 1828, which requires by its 1st section, that from the Little Falls to Georgetown, the depth beneath water surface shall not be less than "*five feet.*" There seems then to be no legal impediment to the adoption of any uniform depth which will not conflict with the aforesaid provisions : and it would further appear from the 1st annual report of the President and Directors of the Chesapeake and Ohio Canal Company, dated June 1st 1829, wherein Gen. Mercer enters upon this subject at some length, that the selection of an uniform depth of 6 feet above the Little Falls, and of 7 feet below, was entirely voluntary on the part of the company.

And there cannot be the least doubt, that if the construction of the works had been such as to enable the various levels to carry these depths with safety, both the convenience and economy of the transportation upon this canal, would thereby be essentially enhanced.

Such however is unfortunately not the case, for the bottom of the Georgetown level has since been necessarily elevated one foot, to remedy its weakness,—upon many of the levels below Dam No. 5. it is found in practice to be sufficiently difficult to maintain a clear depth of four feet,—And even above Dam No. 5, where the construction of the work is infinitely superior to that below, such is the weakness of the canal profile upon side hill, that I strongly doubt whether a greater uniform depth than five feet could there be safely maintained.

Under these circumstances, I would respectfully advise the directors to issue positive orders to all their superintendants of

finished canal, not to attempt keeping up in any level a greater depth of water than "five feet" (which will be just one foot below the tops of the lock gates,) so to arrange their waste wiers as to waste off at once any excess above that depth, and to bring every level up to that limit as soon as it can be economically done.

This conclusion regarding the establishment and maintenance of a maximum uniform depth of "five feet" can be sustained by many arguments not necessary to be detailed here; and it may be observed that five feet water is an ample depth for the convenient transit of boats of 75 tons burden, which of a suitable build, would draw when loaded about $3\frac{1}{2}$ feet, and be tracted by two horses.

To attempt the maintenance of a uniform depth of "six feet" water in this canal, as has heretofore been contemplated, would, I am firmly convinced be productive of such serious and frequent breaches, that the expense would be totally incommensurate with the object: and to keep up that depth in certain levels and not in others, would only be unnecessarily straining the good work, without in any degree remedying the weakness of the bad.

Perfect harmony and peace during the past year has existed amongst the laborers upon the canal line, and the clemency of the Governor of Maryland, in mercifully releasing from the Penitentiary a number of individuals sent there last year for offences under the riot act, far from resulting in renewed acts of disorder, as was feared and anticipated by many good citizens, has had a tendency to calm revengeful feelings, and excite the gratitude of the operatives towards his Excellency.

A more temporary mode of construction having been suggested for adoption in some of the architectural structures of the canal which are not yet begun: I will observe upon this subject, that at this late day to alter materially the plans of the mechanical work, which have been framed with great deliberation, and represent in fact, the embodied experience acquired during the 12 years that the canal has been under construction, would not, it seems to me, be good policy.

Doubtless a present saving could be effected by adopting more temporary plans for some of the mechanical work, but if we look a little forward and bring into view the probable expense and inconvenience of repairs during an active trade; and if we note the proceedings in the north—where the most American experience has been had in the construction and manage-

ment of canals—we shall see successive new structures each outvieing the last in strength, beauty, durability, and of course in cost. We may observe upon the Erie canal where the locks were originally built similar to those upon the lower end of this line, that they are now erecting upon their new work, structures of surpassing strength and beauty, at a largely augmented cost: we find too that after deliberately discussing and gravely weighing, the subject of building their works in a more temporary manner, the Canal Commissioners of New York, have determined upon adhering to their present expensive plan as being naturally the best: and in connection with this matter, in their report to the Legislature of New York, dated January 23th, 1840, they use the following language:

“The commissioners have discovered that to some extent an impression prevails that the plans for the mechanical structures are unnecessarily expensive:

“The experience derived from the use of the canals in this State has pointed out many imperfections. The masonry is too light to resist the powerful influence of the cold weather incident to our climate. Perhaps there is not a single original structure on the Erie or Champlain canal, in which the masonry has not been more or less impaired. The locks first constructed, were generally regarded as combining great strength and durability, but time and experience has shown them to be imperfect.”

Again they say:

“In planning the structures for the enlarged canal, the commissioners were admonished by past experience, of the necessity and importance of giving to every part of them, the requisite solidity and permanence.”

And again:

“If the locks for the enlarged canal had been constructed like those now in use, the cost of the masonry per cubic yard would have been lessened about 50 per cent. and for a short time they might have answered a good purpose: but it is believed that they would soon have become impaired by use, subjecting the navigation to interruptions, and occasioning heavy outlays for repairs.”

Penetrated by the justice of these views I could not recommend to the canal company to resort at this late period of their progress, to temporary expedients, unless their financial condition demands it: yet if the question of finance should necessari-

ly overrule that of engineering, about \$70,000, might be saved by constructing the remaining lockage of rubble stone masonry, with cut stone hollow quoins, and coping; a mode of construction I would prefer to any combination of stone and wood, which would be nearly as expensive and not so durable.

Further, by changing the plans and perhaps the material of culvert arches (which may indeed be advisable) and building the Town creek aqueduct, partly of wood, the aggregate present saving may be increased to about \$100,000.

There is another question involving grave considerations of cost and utility, which ought now to be presented to the directors; it is that of **FEEDERS**.

Before entering upon this subject, however, candor obliges me to admit, that the disposable time I have had to devote to this matter, has proved insufficient for the acquisition of sufficient instrumental data, to enable a final decision to be formed upon the merits of all the rival plans which present themselves and command our attention: indeed all that I can promise myself upon this occasion—with regard to such as possess nearly equal merit—is to indicate the direction in which further examinations ought to be made: though it is true, that to some of the plans of feeding, such insuperable and manifest objections exist, that we may venture to reject them, without any further evidence.

By gauging the north branch of the Potomac, above Cumberland, and also Wills creek, during an extraordinary drought (September 1838,) it was ascertained that the quantity of water then running in these streams was as follows:

Cubic feet.

In the north branch 19.6-10 cubic feet, per section,			
or per minute,			1176
In Wills creek, 3.6-10	ditto	ditto	216

Total running supply per minute, entering, the pool
of the Cumberland dam, in September 1838, 1392

The above gauge of the north branch, though taken with much care, was made by transverse sections and average velocities, upon an uneven site; it may therefore possibly err in deficiency: still, with a reasonable allowance for error, it indicates that the supply of water at Cumberland, will be in very dry seasons, entirely inadequate even to supply the natural consumption of the canal, without providing for the lockage of the trade.

This will more clearly appear, by considering the probable wants of the canal, *exclusive of lockage*: to arrive at a proximate valuation of which we must recur to experience elsewhere.

With this view I have compiled the following table, from a report of Frederick C. Mills, Esq., chief engineer of the Genessee valley canal, made to the canal commissioners of New York, under date of January 23d. 1840, wherein he gives a general summary of those practical examinations which have induced the ablest engineers in that quarter, to adopt as the measure of the loss of water upon canals, from every source of consumption (except lockage,) the rate of 100 cubic feet per mile and per minute.

TABLE:

Compiled from the Report of F. C. Mills, Esq., Chief Engineer of the Genessee Valley Canal, New York, 1840.

Consumption of Water upon finished Canals in New York—caused by evaporation, filtration, and the leakage and waste at the mechanical structures, as ascertained by the following Civil Engineers:

AUTHORITIES.	Canal experimented upon.	Length of the part tested in miles.	Total consumption exclusive of lockage in cub. feet, per mile and per minute.
Judge Roberts,	Erie,	61	90 .16
ditto,	do.	11	100
ditto,	do.	69½	116 .54
ditto,	do.	141½	103 .18
Judge Bates,	do.	79	101 .26
ditto,	do.	20	105
W. H Talcott,	Chenango,	22	107
Three different Engineers,	2 Canals,	404	723 .14

Average of all the experiments 103 7-10.

Mr. Mills further states that,

“Mr. Talcott’s experiments show the loss on 22 miles of the Chenango canal, to be 107 cubic feet, per mile, per minute; of which 66 cubic feet was for evaporation and filtration, and 41 cubic feet for leakage and waste at the mechanical structures: and by using those results as the basis of the calculations on the Genessee Valley canal, he makes the loss for the same causes 106 cubic feet: this small difference is owing to there being a less number of mechanical structures on the latter, than on the former canal.”

The experiments referred to above, were made in 1839, and having been undertaken with the express view of acquiring data upon which to found an accurate calculation of the probable wants of the Genessee Valley canal on $31\frac{1}{2}$ miles of its length, which is to be supplied chiefly from reservoirs—being in fact designed to guide the expenditure of a large sum of money in such works, they no doubt received all that care and attention which an important object demanded, and which justifies an entire reliance upon Mr. Talcott's results.

Some persons may flatter themselves with the hope, that the consumption of water upon the Chesapeake and Ohio Canal, may possibly be less than the above quotations would indicate : for my own part, the investigations of the skillful and experienced engineers of New York, verified as they have been by practice, command my confidence, and induce me without hesitation to assume, that this canal, like others elsewhere, will need, besides its lockage water, a supply from every feeder, equivalent to 100 cubic feet per minute, for every mile of distance fed.

To introduce an intermediate feeder from the Potomac, into the canal between the mouth of the south branch and Cumberland, would, as the work has been planned, be impracticable without great expense : after passing Evitt's creek there, the neighborhood of the mouth of the South Branch is the first place where a further supply of water can be introduced.

From Cumberland to the South Branch, by the line of the canal, is near $19\frac{1}{2}$ miles: this then is the distance to be fed from the drainage of the valley of the North Branch.

Let us now consider the probable amount of water required for lockage; the whole of which, for the thorough trade, must be supplied from the 75th, or Cumberland level; and for this I shall assume the number of boats plying each day upon the canal near Cumberland at 120. (the same number adopted by the U. S. Engineers:) 60 being supposed to arrive and 60 to depart each day, their lockages being assumed to take place independently and not by the "alternate passage."* These boats, if of 75 tons, would be competent to carry downward, during the navigable season, one million of tons, and would draw from the Cumberland dam per day for lockage 120 times

*This assumption is made in order to cover the maximum expense of water, though I doubt not that during an active trade many "altenuate passages" would be made

the prism of lift of lock No. 75, of which, in the face of a probable deficiency of water, I find, with surprise, the lift to be established at 10 feet, the maximum in use upon the canal.

Lockage water required for the assumed trade.

$100 \times 15 \times 10 \times 120 = 1,800,000$ cubic feet per day, or 1,250 cubic feet per minute.

Consequently, with such a trade, the wants of the canal from Cumberland to the South Branch, would require, to satisfy every cause of consumption, the following uniform supply of water:

	Cubic feet.
Per minute for lockage, at 120 locks full per day	1,250
Per minute for all other sources of loss upon $19\frac{1}{2}$ miles, at 100 cubic feet per mile and per minute	1,950
	<hr/>
Demand of the canal per minute	3,200
Supply of running water entering the Cumberland dam in the driest seasons (as before stated) per minute	1,392
	<hr/>
Deficiency per minute, during extreme droughts	1,808

It is proper to remark that we are dealing with extremes in this connection; for in ordinary seasons I doubt not that the supply of water at Cumberland will be enough to enable a moderate use of the canal, as low down as the South Branch. It is only in droughts that it would so completely fail to supply the trade. And if it be asked how, upon such occasions, this prodigious dry weather deficiency is to be made up? the answer is, only by reservoirs upon Evitt's or Wills' creek, or both: for to introduce Evitt's creek as an ordinary feeder, whereby 432 cubic feet per minute might possibly be added to the supply, would not reach the root of the evil, and would still, in dry weather, leave a large deficiency unprovided for.

It would however be prudent policy to defer the construction of any of these auxiliary works, until, by the opening of the canal, its exact consumption (clear of lockage) can be ascertained by actual experiment.

The probable deficiency of water in the North Branch at Cumberland, to supply the consumption of the canal and the lockage of the trade upon $19\frac{1}{2}$ miles, or in dry seasons even the consumption alone upon that length of canal, indicates most clearly that unless the traffic upon this work is to be left like

the navigation of the river, dependant upon the clouds, an intermediate feeder between Cumberland and dam No. 6, will (to make the improvement perfect) be indispensable, even at the very first opening of the navigation of the new canal; and accordingly whenever the directors are prepared to extend their operations, the *intermediate feeder* ought, in this view, to be one of the very first works let: for the idea of putting the canal into complete use through the medium of the Cumberland dam alone, must, it seems to me, in the face of the facts set forth, be necessarily abandoned: though a considerable Spring and Autumn trade might be thus maintained.

I will now briefly discuss the several plans which have been suggested for the intermediate feeder, and in the very outset it may be observed, that such seems to be the extraordinary deficiency of water in the North Branch during droughts, as to establish an absolute necessity for the introduction of this intermediate feeder, *at or near* the mouth of the South Branch; and hence, in this aspect, throws out of the question the plan of introducing a supply below the tunnel; as there would be no means of feeding the $10\frac{1}{2}$ miles of canal, between the South Branch and the mouth of Athy's hollow, where the proposed feeder, from the Pawpaw Bend, was designed to enter the canal upon its 61st level; unless indeed a costly reservoir was formed upon Town creek, to make up the deficiency of supply from Cumberland which would every summer be found to prevail; and the cost of this reservoir being added to that of a feeder in the Pawpaw Bend, *as incident thereto*, would swell its expense so far above that of any of the other plans for accomplishing the same object, as absolutely to inhibit its adoption.

The plans suggested for the "intermediate feeder" are *five* in number, which I will name in succession descending the river and annex a few observations to each :

1st plan proposed for the intermediate feeder, viz: by erecting a dam upon the South Branch and forming about 2 miles of feeder upon its left bank, to pass the North Branch by an aqueduct, and introduce a supply of water upon the 68th level, at a level coincident therewith, and just above Lock No. 68, in the South Branch ferry road.

This was the plan contemplated in 1835 when the definitive location of the canal from the South Branch to the Great Cacapon, was made by me under the direction of the late chief engineer, and for its execution the topography of the South

Branch presents peculiar advantages; a very low depression exists across the isthmus of a great bend, just above the mouth, where with a cut of only 700 feet extreme length and 34 feet maximum depth, we are enabled by the feeder line, to cut off a distance of about 4 miles and gain the advantage of a fall of 13 feet which exists in the river around the bend.

Thus by a stone dam of about 12 feet high across the South Branch, a feeder of near two miles in length, and an aqueduct over the North Branch of 5 arches of 60 feet span and 10 feet rise each, with the water surface of the feeder elevated 27 feet above low water mark at the confluence of the two Potomacs—a height sufficient to enable us with a properly constructed edifice of stone, to cross the stream and bid defiance to the assaults of the North Branch—we could with these arrangements lead the feeder in upon the 68th level, the water surface of which (supposing a depth of 6 feet) is also elevated precisely 27 feet above the same plane assumed for low water.

This feeder being made navigable, as it ought by all means to be, would by the formation of a cheap tow path along the margin of the pool of the feeder dam, form a navigable improvement of some 6 miles in length, receiving and transporting all the trade of the magnificent valley, watered by the South Branch; and the tolls upon these 6 miles, arising from this trade now considerable and annually augmenting—would I question not, very soon pay such an interest upon the money expended in this feeder line, as would at the least, bring down its cost in equivalent capital, to a very reasonable sum.

2nd plan proposed for the intermediate feeder, viz: by a dam erected upon the Town Falls, about $\frac{1}{4}$ of a mile below the mouth of the South Branch, to conduct a feeder into the 67th level. The United States Engineers planned a dam here of only 12 feet high, which their plan of Locking into the river at Alum Hill, enabled them to make so low, and which would in fact have been *too low* to pass Town Creek with safety.

The water line of the 67th Level is laid 19 feet above the water surface of the Town Falls Pool, and would require a dam of 21 feet high to feed it: an examination of the locality in 1835, quickly satisfied me that the erection of a dam of that height, would so flood several most fertile and valuable bottom land Farms, near the confluence of the two Potomacs, as to be almost tantamount to their destruction; which damages at the rate they would probably be assessed at by a Jury, would pro-

duce a truly formidable sum to be expended in the acquisition of land, and the satisfaction of verdicts; this consideration induced an abandonment of the plan at that time.

Recently it occurred to me that we might economically lower the 67th level 3 feet, and thus reduce the height of the dam to 18 feet above its base, and it was hoped that with this reduction and a long overfall to the dam, levels of no very expensive character would enable us to shield the farms from floods, but a recent instrumental survey resulting most unfavorably, has convinced my mind that a permanent feeder from the main Potomac at this point is impracticable at any reasonable cost.

3d plan proposed for the intermediate feeder viz: by a high dam across the valley of Town Creek, not far above the Mill, and at a very favorable site, to form a Reservoir of about 50 feet available depth, and 350 acres surface, and thence conduct a very short feeder to enter the 67th level, by a small Tunnel 225 feet long. This Reservoir, would receive the drainage of about 50 superficial miles of country, and a supply of running water in the very driest seasons, of 186 cubic feet per minute, the assumed surface drained has been ascertained by approximation from information gathered in the country, and the surface (350 acres) which 50 feet available depth would overflow, by a proximate survey made in 1835.

By careful experiments upon the Chenango Canal, John B. Jervis, Esq., Civil Engineer, established the fact that the Madison and Eaton Brook Reservoirs, collected near 2.5 of the water falling in rain and snow upon their vallies.

The fall of rain per annum used by the United States Engineers in their calculations concerning the summit of this canal was that of the year 1822, being 29 2-10 inches, the quantity given in the meteorological tables of Lewis Brantz, Esq., as the down fall in that year near Baltimore, it having been an unusually dry one.

* Sutcliff and Andreossi concur upon the loss from reservoirs being about $\frac{1}{2}$ an inch per day, or say 15 1-6 feet perpendicular per annum.

Applying these data to such information as we possess concerning the valley of Town creek, we may, form an estimate, a very rough one, of its probable capability to fill a reservoir of such dimensions as to feed 30 $\frac{1}{2}$ miles of canal.

* See report, of Col. J. J. Abert, U. S. Topographical Engineer, on the Maryland line.

	Cubic feet.
The down fall water on 50 square miles, at 29 2-10 inches per annum	3,391,872,000
Deduct 3-5ths consumed by the valley	2,035,123,200
	<hr/>
Leaves 2-5ths collected in the reservoir	1,356,748,800
Deduct loss for a mean surface of 300 acres, at 15 1-6th feet per annum	198,198,000
	<hr/>
Reservoir could furnish to canal, if it caught all the drainage	1,158,550,800
Add running supply of Town creek, the mini- mum flow being 186 cubic feet per minute per annum	64,281,600
	<hr/>

Supply Town creek could furnish annually 1,222,832,400

A feeder introduced upon the 67th level, at Town creek, would have to feed up to the South Branch, and down to dam No. 6, in all $30\frac{1}{2}$ miles. This length of canal would require for one season, or 8 months navigation, (bearing in mind that all the lockage water comes from Cumberland,) as follows:

	Cubic feet.
To fill the canal trunk and its widenings in the Spring, say	50,000,000
Leakage, evaporation, filtration, &c. in $30\frac{1}{2}$ miles, at the rate of 100 cubic feet per mile and per minute	1,054,080,000
	<hr/>

Demand of water for one season 1,104,080,000

To recapitulate: Cubic feet.

<i>Supply of water</i> per annum, available from Town creek in the driest seasons, as above given	1,222,832,400
<i>Demand of water</i> for one season's navigation	1,104,080,000
	<hr/>

Surplus 118,752,400

From these calculations it would appear that if the whole drainage of Town creek could be laid by during the wet months for use in the dry ones, there would be, in the very driest seasons, an abundant supply of water for the use of the $30\frac{1}{2}$ miles of canal. And this treasuring up of the winter

down fall, could undoubtedly be accomplished by a suitably proportioned reservoir, for the construction of which the locality affords every facility.

4th.—Plan proposed for the intermediate feeder, viz: By erecting a dam 16 feet high, upon the tumbling dam falls, in the Pawpaw Bend, and by a feeder of 3 miles long, to bring a supply of water from the main Potomac to enter the canal upon its 61st level, at the mouth of Athy's Hollow.

5th.—Plan proposed for the intermediate feeder, viz: By erecting a dam 27 feet high, about $\frac{1}{2}$ mile above Athy's Hollow, to bring in a feeder at the same point contemplated in the 4th plan.

These two plans may be regarded as modifications of the same, both contemplate forming a complete navigation by feeder and slackwater, up to the upstream portal of the tunnel, to enable boats, by locking into the river there, to proceed around the Pawpaw Bend without passing through the hill: in fact to enable the trade to be carried on by boats passing one way, taking the tunnel, and those moving the other taking the circuitous route. Both plans also contemplate introducing their feeders at the same point, the mouth of Athy's Hollow, upon the 61st level.

Against both plans the following objections would lie if either were put in execution, viz :

- 1.—If an independent navigation had been contemplated around the Pawpaw Bend, as auxiliary to the tunnel line, at the time the directors decided upon the tunnel route in preference to a canal around the river, the former would never have been adopted, as the balance of cost would have been largely against it; to adopt now, what could have been much easier attained by conducting the canal around the Pawpaw Bend, cannot be right, unless the adoption of the tunnel line was wrong;
- 2.—Either of these plans would be very costly if constructed in a permanent manner;
- 3.—As the feeder from Cumberland is incompetent to supply the canal lower down than the mouth of the South Branch, the distance between that point and the entrance of the proposed feeder $10\frac{1}{2}$ miles, would be deficient in water, and would need the aid of a reservoir upon town creek, thus prodigiously augmenting a cost in any event very great; by the introduction as an auxiliary of a feeder,

Over the plan of feeding from a reservoir (No. 3.)	{ In receiving the revenue from the South Branch trade upon an additional distance of,	<i>Miles.</i> 36½
Over the plans of feeding from the Pawpaw Bend (No. 4. & 5.)	{ do.	13½

With regard to a current taking place in the tunnel by feeding through it to the lower levels. I will remark firstly, that its motion will be trifling; and secondly, that as the heaviest trade will be descending, it will prove a positive advantage rather than the contrary.

In concluding this subject, I would respectfully advise the directors before deciding upon this important matter of an "intermediate feeder" to instruct their engineer,

- 1.—To make a definite location for a feeder from the South Branch to enter upon the 68th level, and an accurate estimate of its cost.
- 2.—To make such surveys of Town creek as to determine all the questions necessary to ascertain the merits and cost of a reservoir near its mouth, to enter by a feeder upon the 67th level.
- 3.—To comprise in a report all the information necessary to a just decision upon the respective merits of these two plans for feeding the 30½ miles of canal.

If the directors should concur with me in the opinion that all idea of feeding the canal from a dam in the Pawpaw Bend, ought to be abandoned, it would in that case be proper to notify the Baltimore and Ohio Rail Road Company of that fact, in order that they may be enabled to lower their grade in the Pawpaw Bend; where now, apprehensive of our company requiring a feeder dam at the Tumbling Dam Falls, they have traced their road upon a much higher and more expensive level than they need to, or would have done, if they had possessed unreserved command of the valley of the river at the time when the location was made.

Having now touched upon all the subjects of any importance which have occurred to me in connexion with the 50 miles of unfinished canal, I shall pass on to consider the third division of this report.

3—ON THE CONDITION AND PROSPECTS OF THE FINISHED CANAL NOW NAVIGATED 134 MILES UPSTREAM FROM GEORGETOWN TO DAM NO. 6.

It is gratifying to be able to state that upon the finished part of the canal during the past year, breaches have been less frequent than heretofore; thus indicating that the stability of the Banks is gradually augmenting by time, and the continual strengthening of weak points by repair, as fast as they display themselves by leaks or breaches.

The 4th division, being the $27\frac{1}{2}$ miles next below dam No. 6 (with the exception of that work proving more leaky than was expected,) has during the past year fully sustained its reputation for fidelity of construction, the navigation for the time it was open, having like that of last year, remained entirely uninterrupted; it must however be remarked that this division has never yet been tested by a full head of water. The costly improvements upon this part of the line made during this year, at the pool four miles below Hancock, and in the limestone district near Prateas Neck, have (I understand) thus far answered the expectations which were formed of their utility.

The two extensive pools upon the 4th division, at Mrs. Bevans, 4 miles below Hancock, and at Fort Frederick below Licking Creek, especially the latter, will need additions to their embankments to enable them to carry safely 5 feet water; the banks should receive more internal base, be augmented in height, and armed upon their faces with a Riprap; the superintendent of the 4th division has been judiciously directing his attention to these points.

The necessity of elevating the Towpath Bank of the Fort Frederick Pool, and protecting its interior face with rock, will be gathered from a mere statement of the fact that it is about 2 miles long in a right line and 20 feet deep or more, giving manifestly both scope and depth enough to enable a heavy gale of wind to create a sea, which I apprehend deeply freighted canal boats will sometimes find it difficult to weather, these surges rushing with violence against the towpath, would evidently breach it very soon, if not provided with a suitable defence.

Every objection which can be properly urged against River Slackwater Pools, (except current) lies with much greater force against that at Fort Frederick, because the latter runs in a straight line and is therefore liable to be swept by gales

from end to end; whereas a river pool is almost always land locked by its own curvature, it being a rare instance in which the wind would have a fair sweep over 2 miles lineal of water where the depth at the same time approximated to 20 feet, even the very trees which fringe a river bank, would shield the pool to lee-ward: and it is a well known fact that a gale of wind, to raise formidable waves, must have both free range of surface and depth of water to operate upon; for depth is necessary for the action of those peculiar oscillations which form waves, and scope is requisite to give time for the rushing air to draw the particles of water into motion.

There is however another important advantage which pools within a canal, must always possess over a river slackwater, and this is, that the level of the canal water remaining fixed, the towpath of course is never liable to overflow.

A vicious plan of taking earth for repairs from places already weak (merely because the land happens to belong to the company,) has occasionally upon sudden emergencies been practised—indeed necessarily so—by the superintendents.

The remedy for this is plain, the company ought at suitable points upon the beam side of the canal, to acquire by purchase, small lots of ground, whence earth could be conveniently taken for repairs, and as a general rule, no material should ever be excavated for that purpose between the canal and the river, for in addition to the earth in such places being less accessible, its removal has a direct tendency to weaken the earth works of the canal.

So prodigious is the leakage of dams No. 4, 5 and 6, in their present imperfectly gravelled state, that during the past summer the water in their pools subsided so far below their respective combs, that for several weeks it was impossible to introduce more than about 18 inches depth of water over the mitre sills of the Guard Locks, though their gates were thrown wide open for the purpose.

Of course the navigation upon the feeder levels of these dams could not be maintained, and was necessarily suspended for some time. This result was not unexpected at dams No. 4 and 5, but certainly unlooked for at dam No. 6, which, having been built in a much more careful and costly manner, it was reasonable to expect it to be more retentive of water.

Candour however requires the remark, that neither of these dams have ever yet been gravelled to a necessary extent, which, if properly done, ought to prevent leakage sufficiently,

and which I would respectfully advise should be completely done at the earliest practicable period, as the annual exposure of the dams to the Summer's sun must, of necessity, cause *the rot* to destroy them with great rapidity.

Under present circumstances, the leaks in each of these dams seem to be just about sufficient to pass under a head of 15 feet, the entire summer flow of the Potomac during a dry season, leaving 5 feet of the crest of each work exposed for some weeks in almost every year. This indicates dam No. 6 to be the tightest of the three, as the river is considerably smaller at its site than it is at the locations of the others.

The heavy ice freshet of February, 1840, made a large breach in dam No. 4, which has been successfully repaired during the Summer and Autumn, by the superintendent of the 3d division; who also replaced a large portion of the downstream sheathing (which had been injured) with 6 inch plank, which will be a decided improvement, as the old 3 inch sheathing was entirely too light to withstand the tremendous reaction of drift which the figure of the dam causes to take place during freshets with extraordinary violence, both here and at dam No. 5. Indeed, it remains to be seen whether even the 6 inch sheathing will prove entirely successful in resisting those assaults which a radical defect in the figure of the overfall profile necessarily produces.

It was to have been expected that the maintenance of dams of sufficient dimensions and extent to bridle a river so formidable during freshets, and rapid in its downward course from the mountains, would be expensive: it will not therefore be a disappointment to know that the day is not far distant when both dams No. 4 and 5 will need extensive repairs; and this period has been not a little hastened by the Summer exposure before alluded to. Whenever these large repairs are made, which ought to be taken in hand in time, I would recommend that the profile of those works should be altered, so that the overfall may be nearly perpendicular, which will destroy the re-action that now takes place during floods.

The experience of the few last years indicates, in a decided manner, that the traffic of the country bordering upon the Potomac, or what may be called the "*way trade*," will be able to pay all the expenses of the company and keep the canal in repair. This is a very satisfactory prospect, as it will leave the tolls upon the *thorough trade* from Cumberland, to enter the

treasury of the company unencumbered by charges; and hence all the revenue so derived, will be clear profit.

With the view of elucidating some of the subjects treated in this report, I addressed a few interrogatories to the four Superintendants of finished canal, which, with the responses of those officers, I have embodied, for the information of the Directors, in the following tabular statement.

STATEMENT.

QUERIES BY THE CHIEF ENGINEER.		John Y. Young, Sup. of the 1st Division, answers:	Wm. O'Neill, Sup. of the 2d Division, answers:	John D. Grove, Sup. of the 3d Division, answers:	Joseph Hollman, Sup. of the 4th Division, answers:
No.	Substance				
1	What average depth was maintained in your levels during the past seasons?	5 to 6 feet.	4 1-2 to 5 feet.	4 1-2 to 5 feet.	4 1-2 feet.
2	Were embankment breaches more or less frequent this year than heretofore?	Less frequent.	Only one breach since I came into office.	Less frequent.	Neither leak nor breach has occurred this year.
3	Does your division annually become stronger?	The weak parts having been strengthened gradually, I answer yes.	Yes.	Yes.	Yes, except the two large pools.
4	Are the mechanical structures upon your division now in good repair?	Yes: the lock gates having been renewed. The wooden bridges are in bad order.	Yes, except lock gates.	Yes, except lock gates.	Yes, all.
5	Would all the levels of your division now bear "five feet" depth of water?	Yes, with safety.	Yes, with a small outlay upon banks.	Yes, I think so.	Yes, with safety except the two large pools.
6	Will the revenue of the present fiscal year ending May 31st, 1841, exceed or fall short of that of the last fiscal year?	Probably exceed that of last year.	Unable to form an opinion.	I think it will be near the same as last year.	Probably exceed that of last year.
7	Is your division now in good repair or not?	Yes, generally.	It is in good repair.	It is in good repair.	It is in good repair except those pools.

As it appears from the above table, (and from my own knowledge) that never more than 4 to $4\frac{1}{2}$ feet water has yet been maintained in the 4th Division, and as from its costly and careful construction we have a right to expect that it will better carry 5 feet water than any other part of the canal, I accordingly respectfully advise that the Superintendent of the 4th Division be instructed, upon the opening of the navigation in 1841, or soon thereafter, to put up all the levels between Dams No. 5 and 6, to the full depth of "*five feet*" and to maintain that depth during the navigable season.

I had intended to have gone carefully over the finished work, and personally examined every part of it in a thorough manner, previous to making this report; but a want of sufficient time upon the present occasion, absolutely precluded me from putting that purpose in execution, and has compelled me to content myself with furnishing much more meagre information concerning the finished canal, than had been either designed or wished.

In conclusion, I may observe generally of the 134 miles of canal now navigable, that with trifling exceptions, *its condition is good and its prospects satisfactory.*

All which is respectfully submitted by

Your most obedient servant,

ELLWOOD MORRIS,

Chief Engineer.

APPENDIX.

[A.]

*Copy of Ellwood Morris's Letter to President and Director's of Ches.
and Ohio Canal Company. December 3rd, 1840.*

CHES. & O. CANAL. CHIEF ENGINEER OFFICE,

Cumberland, Md. Dec. 3rd, 1840.

To the President and Directors of the Chesapeake and Ohio Canal Co

Gentlemen:—In 1839 the four Principal Assistant Engineers, then upon the line, were required to report on the 20th of November to the then chief engineer in detail, the results of a minute series of calculations made out by them and their assistants, showing the probable quantity of every species of work done, or to be done, to finish the canal. These detailed reports comprising the actual final quantities of the finished works, and containing all the data necessary for a general estimate of the probable cost of the canal from Dam No. 6 to Cumberland, *were actually made in 1839*, and from them as a basis, C. B. Fisk, Esq. the then engineer in chief, engrossed his general estimate of December, 1839.

These original documents being *necessary data* upon which to base a present general estimate, revised by the experience of the past year, and having been made out *officially* by the four principal assistant engineers referred to, are unquestionably the property of the canal company, and ought to be on file in this office.

But having searched amongst all the papers left here by the late chief engineer, I have to report to you that these important documents are not to be found here; they may possibly be amongst your papers at Frederick, but if not there, must have been abstracted by some one.

The original data I have alluded to is indispensable to enable me to frame a satisfactory general estimate of the probable cost of the 50 miles of canal now under construction; for with the present force of engineers, it would require more time to restore that data than could now possibly be devoted to it.

I have further to state for your information, that all the drawings

and plans of works, consisting of plans of the dam at Cumberland, aqueducts, locks, culverts, &c. of which there were formerly a great many in this office, which being the property of the canal company, ought now to be here, and which *were actually here* a few days previous to the 1st of October, are not now to be found, and have evidently been carried off. *The only drawing of any kind*, left here, being a survey of condemnation, since altered and therefore of no use. [B]

I have in progress a search for the papers in Dilley's case, but have not yet found them.

I am also preparing a duplicate register of the papers left in this office by the late chief engineer, connected with transactions upon the canal antecedent to the first of October 1840. One copy of which register I shall deposit in the canal office at Frederick, that the Directors may know precisely what papers were on file here upon the 1st of October, or rather what papers were left on file by the late chief engineer.

Of course as to any business or papers of a later date, they need only refer to me for information whenever any may be required.

The Book of Comparison of works, times of completion, cost, &c. made out some time since under the direction of the President, is not to be found in this office.

Whilst upon this subject, in order that the Board of Directors may be made acquainted with the petty embarrassments thrown in my way by the officers lately discharged by the Board, I will state that upon the Old-town division being merged in the Cumberland division, by the order of the Board of the 16th of September, I directed the assistant engineer at Cumberland, to apply to the assistant at Old-town, for possession of the books and papers belonging to the canal company and in his charge; this application was made upon the 29th of September, but possession of the documents was pertinaciously refused upon some frivolous grounds, until the 15th of November, when they were at last turned over, without any action either on my part or that of the Directors to remove the illegal objections to surrendering the aforesaid property of the canal company.

On account of the detention of these books and papers, no estimate has been made or could be made on sections Nos. 317 and 18, since that, for work done in August, and the Commissioner, at my instance, to avoid seriously involving the contractor, advanced \$13,000 without any estimate until this day, when I shall make out one. He also advanced \$2,000 to Watkins on account of section No. 320; the final estimate on which by the absence of the necessary papers has been delayed more than one month.

Finally during the six weeks that the notes of the line were withheld from us, we were of course unable to give the necessary

stakes to guide the contractors, and for the want of them we shall doubtless on section No 318 be put to some extra charges, when we come to trim that work.

I am gentlemen, very respectfully and truly,

Your ob't servant,

ELLWOOD MORRIS,
Chief Engineer.

[B.]

Copy of Thomas Turner's Letter to Chas. B. Fisk. Dec. 16th, 1840.

CANAL OFFICE,
Frederick, Dec. 16th, 1840.

Dear Sir:—I am directed by the Board, to transmit to you the annexed extract from a letter received from E. Morris, Esq. chief engineer, and to ask of you such information, in relation to the papers spoken of, as within your power to give.

They are not, as far as known to me, among the papers on file in this office, and it is presumed, as they properly pertained to the engineer's office, that they never were here. They are much needed, at this time, to enable the Board to have prepared for the Legislature, about to convene, the estimates and report, which will no doubt then be required.

I have no doubt you will take pleasure in giving all information possessed by you in relation to them, and if in your power so to do, to place the Company and its officers in the way of procuring them. An early answer is desired, and will be thankfully acknowledged.

I am also directed to inquire of you information respecting a table or statement, made out under your direction, just before the sitting of the last Legislature, (by Mr. F. Coyle it is believed) giving a detailed account of the number of sections, locks, culverts, aqueducts then finished—the number then in progress of construction, the work done on them, the number still required and not contracted for, &c. &c.

You will no doubt recognise the paper from the preceding description. It is also wanted, but not to be found in this office.

Respectfully, yours,

THOS. TURNER, C^lk.

CH. B. FISK, Esq.

The extract sent with foregoing letter, was from the letter of E. M., herewith marked No. 1, and from [A] to [B] as thereon noted.

[C.]

Copy of Charles B. Fisk's Letter, to Thomas Turner, Clerk, December 21st, 1840.

Washington, Dec. 21st, 1840.

Dear Sir :—Yesterday (Sunday) evening came to hand your letter of the 16th inst., (post marked the 17th.)

On the 28th of September last, I received at Cumberland in due course of mail, the order of the Board, of the 26th of that month, directing that my services as chief engineer of the Chesapeake and Ohio Canal Company, should terminate with the 30th of the same month.

Having been at that time, in the employ of the canal company in different grades of engineer service, continuously, for twelve years and one month, and there being many questions relating to unfinished business, with which I had been more or less connected, particularly, during the latter part of my service; there being also various papers, notes, memoranda, &c. that were then incomplete, owing to circumstances *beyond my control*, (which I will not now detail) and that could not pass from my hands unexplained without prejudice, it might be, to those whose interests had been to some considerable extent entrusted for a time to my charge; and under such circumstances, having but two days given to me by the Board for the arrangement, preparation and explanation of papers, and so short a time too being allowed, without any previous intimation from the Board that my dismissal was about to take place; and in addition, all this occurring with such attendant circumstances as forbid all intercourse with the present head of the company or the individual named as my successor; under all these circumstances, and knowing that in the two remaining days of my continuance in service, I could not do what would be considered even as a commencement of what was necessary,—I concluded that my proper course was to leave in the office such few papers &c., as could pass from my hands without prejudice to the interests of any individual or of the company, and which required no explanation, and to take the others with me to Washington where the canal office then was, for the purpose of arrangement and of written explanation at my earliest convenience and leisure. Having much to do at the time, my directions were necessarily general to Mr. Bryan, who assisted me in putting up the papers, and I have no doubt that some papers, field books &c., may have been taken, needing no explanation from me, that might have been left, but which at the same time cannot by possibility be needed for reference for a year or more if ever, and which therefore, it was thought best should occupy their proper place along side of the other papers, &c., to which I proposed giving my attention so soon as time should permit.

The papers destined for Washington, were placed in boxes along

with my private library and papers, as best suited the convenience of packing, and were then sent to Hancock, to be forwarded by the earliest boat to Georgetown.

My calculation was, that they would be in Washington so soon as my arrival, but it seems that the canal was not navigable at the time, and in consequence, the boxes did not reach Washington, until I was required by the counsel for the company to be in Baltimore, to be present at the McLaughlin trial. From Baltimore I did not return to Washington until the evening of the 8th of December. Since then my whole time has been occupied, arranging my private books and papers, (more than 9-10 of the whole in bulk, but comparatively easy to dispose of) and have barely reached the papers referring to the canal. These papers will now receive my attention, except only at such intervals as private business may prevent, until they shall have been disposed of.

The course I have taken was, and still is regarded by me, as the only one, under the circumstances, that could have been pursued, having proper regard to the interests of the company and of individuals, and keeping at the same time in view, that self respect that I shall ever endeavor, individually to maintain, and professional respect which no member of any profession should ever disregard.

There are members of the Board of last year, and perhaps some of the present year, who have not forgotten that I urged against a certain change of organization occurring just at the time when it did, giving as my reasons, that the winding up and the closing of the then recently abandoned contracts, could not be done, and the calculations connected therewith be made, by other than those officers who had had immediate charge of the respective works, unless at the risk of loss and injustice to the company, and to the contractors, and of great confusion to the works and papers of the engineer department; some comparatively little additional time I stated would enable the officers referred to, to close up satisfactorily their calculations and to arrange their papers. This advice was not followed. Again in some more recent actions of the Board, the chief engineer was lost sight of entirely, in matters that under the regulations of the Board (never to my knowledge repealed) were exclusively within his province for action and determination; the tendency and effect of which, were confusion and embarrassment. I make this brief reference to the past, merely to remark that more time may be requisite than otherwise would have been necessary for the arrangement &c. of papers above spoken of; and that after all, the result may be very unsatisfactory.

The papers most particularly enquired for in your letter, are the reports of the principal assistants in Nov. 1839, upon which was based the general estimate of December of that year, and a table or statement prepared under my direction at the Canal Office last winter.

The *general estimate* of December 1839 and the statement referred to, I have frequently seen at the Canal Office in Washington within the last year, rolled and tied up together.

Often when in Washington heretofore, I have had occasion to borrow general estimates and other papers from the Canal Office, for reference in reporting upon some questions presented to me at the time by the Board, and requiring an answer from me while in Washington.

In this way papers from the Washington office have occasionally got among my other papers, and been taken along with them to the office in Cumberland. It is possible that this may have happened to the general estimates of December 1839. After closing this letter, (to be in time for the evening mail) I will make search for this general estimate, which if found, will be accompanied, I am confident by "the statement" rolled up in it. But in case "the statement" should not be found, a copy of it shall be sent to Frederick. (There were two prepared last winter, the original draught and the office copy.)

Should the general estimate of December 1839 be found, (and it must be in the office at Frederick, if not among the papers here,) it will furnish the information in detail sought for from the reports of the principal assistants, with the exception that the general estimate has certain corrections, additions, &c., made by me, but upon this subject I will write again by to-morrow's mail, after having searched &c.

The "statement" and general estimate, (should the latter be found) if you so direct, shall be sealed up and sent by the Frederick stage.

Yours, very respectfully,

CHARLES B. FISK.

THOS. TURNER, Esq., Clerk Ch. & O. C. C.

[D.]

Copy of Charles B. Fisk's Letter to Thomas Turner, Clerk, December 22nd, 1840.

WASHINGTON, Dec. 22d, 1840.

Dear Sir:—I find in my possession the original general estimate of December 1839, which must have been borrowed by me for reference while in the city, within the last year, when making out some report called for by the Board, as suggested in my letter of yesterday, but I do not find with it as I had anticipated that I should, "the statement." This last I think you will find in the office at Frederick.

I shall seal up to your address the general estimate and a copy

of the "statement," to be forwarded to Frederick, in such way as you may direct.

The reports of the principal Assistants of November 1839, furnished mostly, all the details of the general estimate, but, as intimated yesterday, such corrections and alterations, deductions and additions, were made in transferring the details from the principal Assistant's reports to the general estimate, as were deemed necessary by me. The reason for such changes I can give when time shall permit it—which being done, the reports of the principal Assistants can, with propriety, be passed from my hands; but for the purpose in view, as stated in your letter, the general estimate will, probably, be found all sufficient.

In reference to the plans of work and other papers in my possession at the time of my dismissal and not left at Cumberland—I shall select such as are perfect and complete and properly belong to the company—to be placed in the Canal Office; and those plans, papers, &c. that are not complete and perfect, I shall endeavor to make so, that they also may be placed in the Canal Office, so soon as time and leisure and the information within my reach, shall enable me so to do.

My professional character and reputation demand the course I have adopted, and in this I am sustained by the usages and the practice of the profession; and it gives me pleasure to add that the interests of individuals and of the company, so far as I am concerned, and under the circumstances, could in no other way be better promoted.

Yours, very respectfully,

CHARLES B. FISK.

THOS. TURNER, Esq. Cl'k. C. & O. C. C.

[E.]

Copy of Thomas Turner's Letter to Charles B. Fisk, Dec. 26th, 1840.

CANAL OFFICE, }
Frederick, Dec. 26, 1840. }

Dear Sir:--Yours of the 22nd inst. is received—in reply permit me to express the hope that you will forward immediately, to my address, all the papers spoken of. They are much needed, as no communication can be made to the Legislature, or application for funds, until Mr. Morris has made his report, which he cannot do until he has received the papers now in your possession; as they will, no doubt, form too large a package for the mail, I would suggest their being put up safely and sent by the stage.

I am directed to ask of you all papers belonging to the Compa-

ny, in your possession, and to say, that on any future occasion, should you find it necessary to examine them for any purpose, you shall have access to them at the office, and your expences to and from this place will be paid by the company.

I have not been able to find the "statement" spoken of by you, and as a general overhaul of the papers has been made, I suppose it is not to be found here.

Yours &c.

THOMAS TURNER, Clerk.

CHAS. B. FISK, Washington.

[F]

Copy of Charles B. Fisk's Letter to Thos. Turner, Clerk. December 28th, 1840.

Washington, Dec. 28th, 1840.

Dear Sir—Your letter of the 26th inst. is just received.

I shall immediately leave at the Frederick stage office, to be forwarded to you in the morning, the General Estimate of December 1839, and the "statement," sealed per to your address.

Very respectfully yours,

CHARLES B. FISK.

THOS. TURNER, Esq.

Clerk Ches. and Ohio Canal Co.

[G.]

Copy of Ellwood Morris' (Chief Engineer.) Letter to the President and Directors of the Chesapeake and Ohio Canal, Jan. 4th, 1841.

Frederick, Md. Jan. 4th, 1841.

To the President and Directors of the Chesapeake & Ohio Canal Co.

Gentlemen:—The chief Clerk has placed in my hands Mr. Fisk's general estimate of 1839, as having been received from that gentleman, in answer to a request that he would furnish, if in his custody, the four reports of the Principal Assistant Engineer's, made in 1839, the absence of which from the Chief Engineer's Office, at Cumberland, I have heretofore reported to the Board.

With the aid of these reports, which embodied the results of the calculations of probable quantities contained in each species of work upon the Canal—which, in fact, comprised the details upon

which Mr. Fisk's estimate was founded, and from which it was engrossed—it would have been in my power ere this time, by inserting in their proper places the final results on works finished in 1840, and by substituting exact for proximate calculations, in some instances, to have supplied to the Directors a satisfactory estimate.

Without the aid of the reports alluded to (as data) I am unable to submit that estimate now.

And as I presume it is an estimate received from original papers by the experience of 1840, that is desired by the Board, and not a copy of one made in 1839, the document placed in my hands by the Chief Clerk does not advance the present purpose.

In speaking heretofore of the reports of the four Principal Assistant Engineers of 1839, as being *indispensable* to enable a satisfactory estimate to be framed, I mean to be understood, that they are so *indispensable* to the fulfilment of the orders of the Board, owing to the limited time allotted to me.

For it is manifestly practicable, by great labor, to restore from the primary levels of the ground and from plans of the work, all the information condensed in these reports, but it must also be equally evident, that in many instances this will be merely moving over ground already travelled, producing a waste of time totally unnecessary if the Company were not debarred possession of their own property.

Nevertheless, this labor of restoration has been commenced and will be persevered in, until a result is attained, which it will be my earnest endeavor to make as satisfactory as circumstances will permit.

I am gentlemen, very truly and

Respectfully your obd't. serv't.

ELLWOOD MORRIS, Chief Eng.

